

CHEMICAL & METALLURGICAL ENGINEERING

McGraw-Hill Co., Inc.

June 14, 1922

25 Cents Per Copy

THERMALLOY

*The Standard Heat Resisting Alloy
at a Reasonable Price*

Thermalloy can be turned, drilled, filed, threaded, forged and drawn into tubing.

Thermalloy heats through more rapidly than new unoxidized steel or cast iron.

Thermalloy heating efficiency is not affected by continuous service.

Thermalloy is cast in shapes of all sizes, large or small.

Thermalloy is obtainable at a reasonable initial cost and is cheaper per heat hour per pound of product than any other heat-resisting alloy.

It will be the solution of your troublesome problems of oxidation at high temperatures.

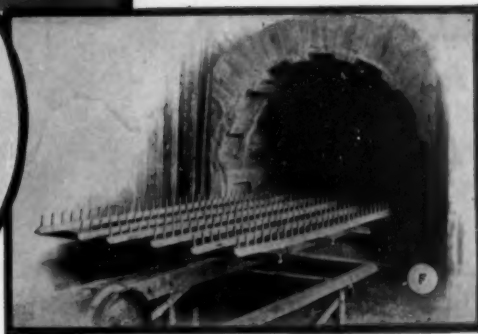
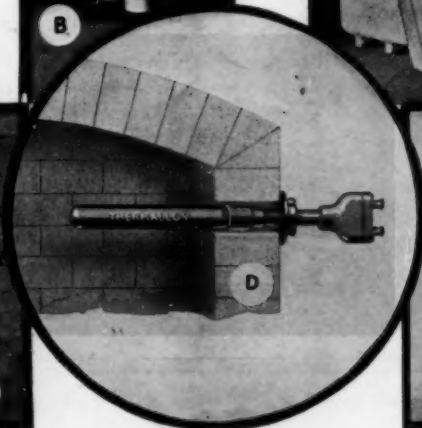
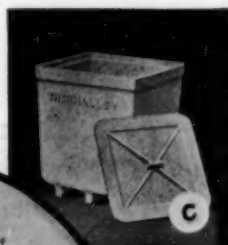
THE ELECTRO ALLOYS CO.

Elyria, Ohio

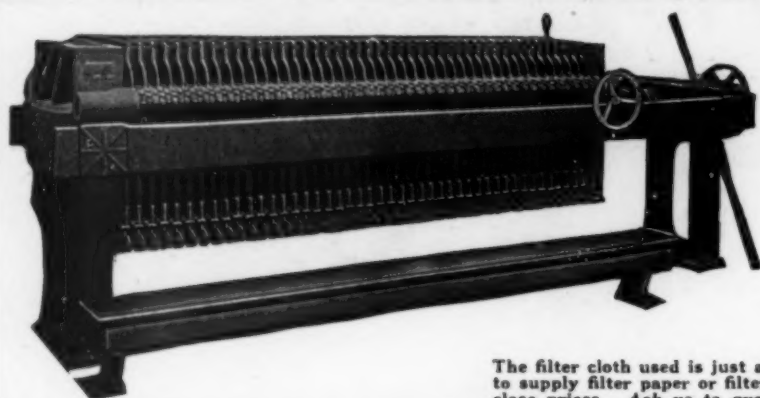
New York City
40 Church St.

Cleveland, O.
511 Buckley Bldg.

Detroit, Mich.
403 Real Estate Exchange



See page 27
for detailed
description of
illustrations



Shriver Efficiency

Many years of producing filter presses for all types of filtration work enable us to guarantee the results.

This guarantee of efficiency goes with every filter press we sell—we know our product, and we are ready to stand back of it. Write for catalog, stating your filtration problems.

T. SHRIVER & CO.

808 Hamilton Street, Harrison, N. J.

The filter cloth used is just as important as the filter press. We are in a position to supply filter paper or filter cloth especially woven for filter press work, at very close prices. Ask us to quote on your filter cloth requirements.

DRYING MACHINERY

The most satisfactory, durable and economical dryers for



CHEMICALS
PAINT COLORS
PHARMACEUTICALS

LEATHER
CERAMICS
SOAP

TEXTILES
PULP BOARD
HAIR, etc.

Standard types backed by long and successful records of service, or special designs for individual needs. Each "Proctor" Dryer is fully guaranteed as to capacity and results.

PROCTOR & SCHWARTZ, Inc.

NEW YORK

PHILADELPHIA, PA.

CHICAGO

Varsity Automatically Controlled ELECTRIC DRYING OVEN

New Double Walled Type



Built of Asbestos transite. Cast aluminum frame door and shelf racks.

Base of cast iron of substantial design. Heating element removable. Bimetallic regulator for any desired temperature between that of the room and 160° C. Contact points outside of oven to avoid danger of ignition when drying inflammables. Furnished with switch, pilot lamp, adjustable ventilators, cord and plug.

Small size, Inside dimensions: 10 in. x 10 in. x 12 in. high.....\$60.00
Large size, Inside dimensions: 18 in. x 16 in. x 9 in. high.....\$80.00

EIMER & AMEND

ESTABLISHED 1851

Headquarters for Laboratory Apparatus and Chemicals

NEW YORK CITY, N. Y.
200 East 19th St.

PITTSBURGH OFFICE
4048 Jenkins Arcade

WASHINGTON, D. C., 601 Evening Star Bldg.

CHEMICAL & METALLURGICAL ENGINEERING

ELLWOOD HENDRICK
Consulting Editor
ERNEST E. THUM
Associate Editor
ALAN G. WIKOFF
Industrial Editor
J. S. NEGRO
Managing Editor

A consolidation of
ELECTROCHEMICAL & METALLURGICAL INDUSTRY and IRON & STEEL MAGAZINE
H. C. PARMELEE, Editor

R. S. McBRIDE
SIDNEY D. KIRKPATRICK
A. E. BUCHANAN, JR.
GRAHAM L. MONTGOMERY
CHARLES WADSWORTH, SR.
CHARLES N. HULBERT
Assistant Editors

Volume 26

New York, June 14, 1922

Number 24

Less Politics

And a Better Tariff

WHILE Republicans and Democrats alike were inclined at first to be hostile to the Senate Finance Committee's proposal to introduce an element of flexibility in the tariff, there is an increasing recognition of the meritorious features of such a provision. Sentiment in that direction is being encouraged each day as the debate drags along in the discussion of details with which Senators can have only limited knowledge. It is becoming more apparent that machinery must be set up to give an opportunity for all concerned to be heard and to make possible the adjustments that economic changes require.

Those who oppose giving the President power to alter rates see in it not only the surrender of valuable prerogatives but fear that the President will be influenced to grant favors to special interests. As is well known, the plan for a flexible tariff contemplates a study of each case by the United States Tariff Commission. The President would act only on its recommendation after the particular case had been carefully studied by that body.

The idea is to handle tariff matters in much the same way that the Interstate Commerce Commission adjusts freight rates. If Congress were to attempt to pass upon the reasonableness of railroad rates, it is very apparent that intelligent action could not be had. With the increasing intricacy of the interchange of goods between countries, the tariff is entirely comparable, in diversity, with railroad rates.

If the flexible provisions are written into the law—and it is believed on Capitol Hill that this will happen—complaints probably will be filed with the Tariff Commission just as rate cases are now initiated with the I. C. C. With machinery much like that being operated by the Interstate Commerce Commission, careful consideration can be given to all phases of the particular duty involved and ample time provided for all concerned to be heard. This usually is not the case with Congressional committees. Notwithstanding the fact that the Senate Finance Committee was unprecedentedly liberal in the time it accorded witnesses, there were many instances where millions of dollars were involved and yet only two hours could be given to the entire discussion. When it is considered that Senators have manifold duties, there is little possibility of their being able to familiarize themselves with the economic situation surrounding the thousands of articles affected by a tariff bill. Furthermore if railroad rates could be adjusted only once in four years, great inequities would be occasioned. Just such inequities are being worked by the existing tariff policy, although these will not become fully apparent until the elastic system has been put into operation. A sudden change in industrial methods

abroad frequently has resulted in very serious injury to an American industry. An example is had in the Canadian process for making acetic acid synthetically from acetylene. In other cases, actual practice frequently demonstrates that a rate is too high or too low. If the lesson of experience could be applied immediately, great losses and unnecessary burdens could be avoided.

The Need of Another

Hearing on Chemical Warfare

DR. JOHN BASSETT MOORE, former Counselor of the Department of State and now a member of the lately created International Court of Justice, has been appointed to represent the United States on the Rules of Warfare Commission authorized by the recent Disarmament Conference. This High Commission is to consist of not more than two representatives each for the United States, Great Britain, France, Italy and Japan. The time and place of meeting are still to be determined. The names of the other members of the commission have not yet been made public.

We have been in communication with Dr. MOORE, with a view to providing a way for the presentation of a memorial in relation to chemical warfare. He reminds us that "the commission shall be at liberty to request assistance and advice from experts in international law, and in land, naval and aerial warfare," and points out that the question of assistance and advice from experts is one which the commission as a whole rather than any single member of it is to regulate. He very naturally desires to avoid saying anything just now which might place him in an attitude of speaking for the commission in advance of its constitution and organization.

We sympathize with him in his attitude. But that does not relieve us of our obligations. The learned International Disarmament Conference at Washington concluded that there is to be no more chemical warfare. There were two opinions presented on the subject: One, that it is wise to declare that there is and shall be no such thing, and the other, recognizing its existence, to establish measures of control. The conflicting opinions were presented respectively by

1. Statesmen and lawyers who are unfamiliar with chemical and physical processes, and representatives of the military service that do not know how to use chemical warfare for offense or to meet it in defense.

2. Chemists and physicists who recognize the constant possibility of the use of these munitions and that in a conflict at arms the force that uses chemical warfare against an unprepared army is almost certain to win. Supporting these was the smaller section of the military service that is familiar with chemical warfare

in offense and defense, and that realizes its effectiveness.

The members of the conference were themselves statesmen and lawyers, also unfamiliar with the processes and principles of science, and they listened with greater favor to the talk of the uninformed than to the advice of the informed. It was the old situation with which we are familiar in industry: When science gets a hearing the listeners either will not or cannot understand.

Here is a weapon of offense that doubles the potency of munitions, that can put regiment after regiment of enemy troops *hors de combat* at once, make them prisoners of war, and yet avoid a single fatal casualty. And it can also deal death at wholesale. The wrath of man is one of the devastating forces of nature, and when it bursts out into war it is, like fire and flood, a monster of destruction. Anger is madness, and we cannot reason with madness. Now chemical warfare is a weapon already developed and at hand. At any time in future wars chemical munitions will be available, like a loaded pistol, quickly made ready for use—and we are sure to discover that to forbid their use will not prevent it.

War is different from peace. There is not even a *code duello* among nations. Consider, for instance, the many phases of "military strategy" and how criminal and dishonorable the very substance of it is in times of peace! We repeat that in time of war we are dealing with madmen. Soldiers won't fight until their wrath is aroused. And the great conference in Washington agreed that in the event of such madness no signatory power was to misbehave in the matter of chemical warfare.

What will a signatory power do if it finds itself engaged with an enemy that uses so-called chemical munitions? How binding will that agreement be when such an enemy begins to conquer?

The High Commission that is about to assemble will consist of statesmen and lawyers. It is doubtful if a single man of ripe scholarship in physical science will sit in conclave. They will be men of great legal learning and of splendid type, judged by the American representative already named. What they will need to know is the ease and secrecy with which so-called chemical munitions may be launched when the fortunes of war turn against an army in battle. They will be eminent humanists who are familiar with the workings of the human mind in peace and in war. With the facts properly presented it is to be hoped that they will not, as did the Washington Conference, close their own minds to the unfamiliar language of science.

The subject is of supreme importance because civilization as we understand it is at stake. The weapon is always at hand, and it is sure to be used. To forbid it and let it go at that is like cautioning a Sicilian, engaged in a struggle to the death with his mortal enemy in a dark alley, not to draw his stiletto, or to request a negro to keep his razor in his boot during a fight.

It is the duty of the chemists of the United States and England, France, Italy and Belgium to explain the nature and operation of chemical warfare to the High Commission so that its members can really understand. It is difficult to explain, and the situation is difficult to meet, but that does not exonerate us from our duty in trying to make matters clear. Now is the time for our chemical societies to appoint committees to get the memorials ready to present.

Labor Unions Are Suable

ON THE simple and reasonable basis that it is utterly impossible to do justice otherwise, the United States Supreme Court held on June 5, in the case between the Coronado Coal Company and the United Mine Workers, that strike funds are assessable for damages and that a labor union is suable despite the fact that it is not incorporated.

The decision is of the greatest importance, for there has been agitation for 15 years or more in favor of legislation requiring the incorporation of labor unions. The argument was that the unions were evading responsibility for their acts and escaping the penalties of the law by not incorporating. The Supreme Court now settles this matter. The evasion of failing to incorporate cannot be employed. This seems elementary. It was possible to sue before there were corporations.

The law does seem to be growing more human as we build up interpretations of it. There is the Sherman law of July 2, 1890. For several years it was thought to be so drastic as to be unenforceable, and was considered a dead letter. There was agitation for amending it by writing in the word "reasonable," which would be rather unreasonable, for a "reasonable restraint of trade" would be contrary to the general spirit of law, which requires in most cases that a motive—or reason—be shown. Some years ago the Supreme Court settled the matter by asserting that the Sherman law must be interpreted "in the light of reason," which is really a totally different thing. That is, one cannot be convicted under the law on a mere technicality. Now the Supreme Court holds that a labor union cannot escape by a mere technicality.

On various occasions Congress in making appropriations for government expenditures has provided that no part of the funds should be used for the prosecution of labor unions. The limitation was tantamount to an admission that under the law labor unions are subject to prosecution, and Congress simply degraded itself. It did not enact legislation by imposing such limitations on the expenditure of funds appropriated. The limitations were obtained simply by the activity of the labor union lobby. The issue was not raised in such a manner that the general public would take a deep interest, particularly so since an appropriation is an annual affair, while legislation is permanent unless repealed. Should the labor unions now attempt to have Congress modify the law under which the recent Supreme Court decision was rendered, the whole thing would be brought out into the open and Congress would quickly have forced upon it knowledge that the public will not tolerate legislation to exempt labor unions from the operation of the laws of the land.

Repeatedly during the past few years distinguished leaders of thought in industrial relations have urged that laws in restraint of trade be applied to capital and labor alike. The incorporation of labor unions was advocated at President WILSON's first Industrial Conference and staunchly opposed by Mr. GOMPERS, who proudly declared that it is impossible to incorporate human souls. This was a fine gesture, but it made no impression as a sound argument. Apparently the Supreme Court has visualized the whole situation very clearly and we may reasonably hope that henceforth labor unions will act and speak with due regard to their responsibility as organized bodies of men.

Byproduct Coking Continues to Gain

DESPITE the interruption of coal supply by the strike the output of byproduct coke has continued to increase since the first of the year until in April 2,227,000 tons was made. This represents about 90 per cent of the rate of production in 1920, when the average output was the maximum ever attained in the history of this industry—namely, 2,565,000 tons per month.

Not only is there this evidence that the byproduct industry is progressing steadily toward high-capacity operation, but also it has recently been announced that a tremendous extension will be made of the coke plants of the Eastern division of the U. S. Steel Corporation. It is stated that another plant even larger than the present Clariton plant will be erected in the near future in order to insure that the metallurgical coke supply of the East will be maintained without dependence upon the beehive branch of the industry.

Long ago the ultimate doom of the beehive oven was foreseen. But the war period and industrial conditions since the war show that even the more optimistic prophets were not unduly sanguine. Already much over half the coke supply comes from byproduct ovens. Soon it will be three-quarters of the total, and one might even dare to forecast that within a decade the beehive branch of the coke industry will be an altogether negligible part of the total when figuring the industry on a national basis. Locally it will, of course, remain in many districts an important or even dominating factor. But as a whole the more efficient system, the one which conserves the more valuable portions of coal will prevail.

Setting a Bad Example

ANNOUNCEMENT has been made by the American Petroleum Institute that hereafter the hydrometer scale with the modulus of 141.5 will be known as the "A.P.I. scale" (American Petroleum Institute scale). Thus at last the petroleum industry recognizes that hydrometers made according to this standard cannot properly be called "Baumé." Also this terminates the long-standing controversy between the Bureau of Standards and the petroleum industry regarding testing and use of this type of instrument.

It is most unfortunate that commercial considerations prevent the petroleum industry from abandoning altogether this hydrometer standard. It has no real excuse for existence on the score of science or technology. It originated from erroneous manufacturing practice and the fact that it has been permitted to take root and grow up within this industry is certainly not to the credit of petroleum technologists. It is commendable, however, that the scale is now recognized by a distinctive name and that the industry no longer attempts to use the A.P.I. standard under the name Baumé, as has often been the former practice.

There is really a question in our own minds as to whether the reasoning which led to the perpetuation of this standard is sound. The industry feels that a change in hydrometer standard would mean a change in specifications that would be unacceptable to the customers or else the loss of the certain fraction of a degree just at the limiting point of gravity specifications. This small change in the limit of gravity would be particularly important on such products as gasoline and would have real dollars-and-cents significance.

Nevertheless it does seem unfortunate, to say the least, that the actual gravity of petroleum products cannot be recognized by hydrometer specifications which are acceptable in other industries and which could for all but this one commercial reason quite readily be used in petroleum marketing. It is certainly to be hoped that other industries will not emulate this example of special standards, for we already have far too many methods of expressing specific gravity.

Old Man, Go Back to School

OVER fifty years ago HORACE GREELEY created a magnificent slogan. When he said: "Go west, young man," he stimulated the imagination of the youth of his day and many followed his advice. We have no such slogan, but we have a message, "Go back to school, old man!" Study some more. Round out your development. Enlarge your point of view. There's an answer to "Why?" and "How?"

It is true that there are fewer chemists unemployed now than there were in August, so our friends in the employment bureau of the Chemists' Club tell us. Nor will there be great difficulty in placing this year's crop of graduates. It is also true that some firms are waiting till this year's graduates are ready before filling in their organizations because they are looking for cheap men. But what will be the fate of these graduates in industry? Their position almost without exception will be routine. Advancement will usually be very slow and a dead wall will be encountered over which there is no jumping in that company. Another company will treat them little better. Gradually from the control laboratory they will drift into the plant. Their progress will always be slow because they have not the technical equipment for pulling themselves above the average. This has been the experience of the vast majority of chemists and chemical engineers in the past. Their salaries remain low and their work stays routine.

As distinguished from the average is the group of chemists and chemical engineers who have taken this additional training. In general their progress through the research and operating departments is more rapid. They hold the desirable positions both from the standpoint of compensation and of interest. They had completed a college course before they entered professional training and then they had returned for graduate work and training in research. In short, their more mature mentality was stimulated by their study.

These two classes are not completely differentiated. They overlap. Men without additional training dominate. Men with it are submerged in routine. But the distinction is there. There is no escaping the essential fact. Success is in proportion to background, education and training.

And this year with the average weekly wage probably less than \$25 and with the general history of the profession as it is, "Go back to school, old man." With two or three years of research behind you and with the true significance of Ph.D. after your name your services are much more easily marketable. With a year or two of research you will be able to lift yourself out of the technical routine. With a year or more of engineering studies or advanced courses you will be out of the routine class. Beg, borrow or—no, don't steal, but work for your expenses. It can be done. And the return on the investment is several hundred per cent.

Readers' Views and Comments

Atmospheric Pollution From Sulphuric Acid Plant Fumes

To the Editor of Chemical & Metallurgical Engineering

SIR:—I desire to call attention to two omissions in the article on "Atmospheric Pollution From Sulphuric Acid Plant Fumes," which you published under my name in your issue of May 24, 1922. Your readers may recall that the writer, in summing up the work of the committee of the American Institute of Chemical Engineers, stated that "the report of the committee places squarely upon the shoulders of the Manufacturing Chemists' Association the responsibility for further advances and action in this matter. Unfortunately in your abbreviation of the manuscript, however, you omitted the particular paragraph in the official report of the Institute's committee on which my statement had been based. That paragraph reads:

The committee believes legislation and regulation concerning atmospheric pollution are more properly the subject for action by the chemical manufacturing associations, but that the Institute should hold itself ready to co-operate with such associations when called upon.

Of somewhat less importance but nevertheless of current interest in connection with the paper Dr. O'Gara is to present before the Institute's meeting at Niagara Falls on June 19 is the second omission:

Your committee has especially requested Dr. P. J. O'Gara, head of the department of agriculture and smelter byproducts investigations of the American Smelting & Refining Co., Salt Lake City, Utah, to publish at the earliest possible date the conclusions of his notable work on atmospheric pollution.

I am grateful to you for the opportunity of bringing these matters to the attention of those of your readers who are interested in the important subject of atmospheric pollution.

JAMES R. WITHROW.

Columbus, Ohio.

Electric Steel in California

To the Editor of Chemical & Metallurgical Engineering

SIR:—In the May 3 issue of CHEMICAL & METALLURGICAL ENGINEERING the author of the article on the Electric Steel Plant at the Southern Pacific Shops made certain statements upon which I desire to comment.

Under the subject of "Cost," in the second column, the statement is made that the electric furnace was selected for this plant on account of a smaller production cost, when compared to other forms of melting equipment. In referring to open-hearth operations the author then continues: "Inability to obtain 'hot metal' for the open-hearth furnace militated against this process." I do not see why any plant in California should exclude the open-hearth furnace from an installation on this account. California already has open-hearth furnaces in operation producing over 30,000 tons of steel a month, using scrap only, scrap and ore, or cold pig scrap and ore. These furnaces are producing ingot steel at less cost than can a Heroult furnace of the capacity described, comparing steel of the same grade and analysis. The inability to obtain hot metal is no well-founded reason for eliminating the open-hearth furnace, with the con-

ditions for steel manufacture and supplies of raw melting stock existing on the Pacific Coast. The engineers who decided the choice of furnace for this plant may have desired to use the hot metal pigging process, but this is no interference unless an iron blast furnace were operating with a hot metal surplus from its casting requirements.

The author states also, "Furthermore, on account of the refractory nature of California iron ores, the erection of a blast furnace in this region is a very distant possibility." There are no refractory iron ores in California, considered as commercial ores of iron. The nature of the iron ores from a metallurgical or chemical standpoint has not contributed to the delay in establishing blast furnaces and reduction plants. In Placer County a plant operated in 1881 and produced over 5,000 tons of merchantable iron. The fact that California magnetites and hematites are suitable for pig-iron production has been demonstrated and proved since 1881, and in recent metallurgical history they have been proved suitable for electric reduction also. There seems to be current rumor in certain uninformed and misinformed circles on the Western Coast that the iron ores are not suitable for iron production. Until I read this article I never heard of a California iron ore as exhibiting any "refractory nature," and I have been working on the Pacific Coast with such ores since 1909.

R. C. GOSROW,

Metallurgical Engineer.

Chicago, Ill.

Ido, the New Universal Language

To the Editor of Chemical & Metallurgical Engineering

SIR:—I note with interest the letter on "Ido, the New Universal Language," by Earl Walter Sutton, and I believe it will help the cause of introducing the international language. He said at the end, in regard to Europe: "I am informed that Esperanto is there meeting with the fate of Volapuk—obscurity." I believe he is wrong in this, as I follow the Esperanto movement quite closely and only wish it were spreading with the same rapidity in America as in Europe.

The difficulty that we international language people are chiefly confronted with, it seems to me, is prejudice against any artificial language. It would, therefore, be a good thing if all of us international language people could get together and agree not to throw one another down, or claim special perfection as against the others, but try to overcome the inherent prejudice of humanity.

In an article recently published in the new International Year Book, 1921 (Dodd, Mead & Co.), the writer of international languages seems to think that Esperantida (the latest) is going to win out.

I wish Mr. Sutton would put these three languages in parallel columns and let us know without prejudice what he thinks of their respective merits. I believe he would find that there is not 5 per cent difference in their virtues; hence the more reason for getting together and letting the truth hit where it will.

G. W. LEE,

Librarian, Stone & Webster, Inc.

Secretary, Esperanto Association of North America.
Boston, Mass.

Meeting of American Foundrymen and Institute of Metals

Rochester Entertains Foundry Trades—Prominent Metallurgists From Europe and Canada
Guests of the Association—Ten Technical Sessions on Various Phases of Iron, Steel and
Non-Ferrous Foundry Technique—Attention Also Paid to Industrial Relations

AFTER an interval of 18 months, spanning the business depression, the American Foundrymen and the Institute of Metals held a very successful joint meeting at Rochester, N. Y., June 5 to 9. According to custom, an extensive collection of modern foundry and shop equipment and supplies was on exhibition by over a hundred manufacturers and firms, and was visited by large numbers.

The selection of meeting and exhibition places was much happier than the last. Rochester possesses far more hotel accommodations than Columbus—an important detail bearing upon the enjoyment of any gathering—and the local committee having this matter in charge was very efficient. Technical sessions and the exhibits were held in Exposition Park, where a number of substantial buildings are set amid charming lawns, trees and flowers. Indeed, out of doors provided active competition with the business of the day.

As usual, many entertainments and plant visitations were provided. Governor Allen of Kansas was the principal speaker at the annual banquet, which, as is usual nowadays, was converted into bedlam by a company of "musicians" whose principal claim to fame is the possession of tremendous lungs and amazing endurance. Not the least of the feature events was a boat ride on Lake Ontario, where, in the apt language of the official announcement, "Lunch and supper will be served and refreshments will be provided continuously."

EUROPEAN EXCHANGE PAPERS

Shortly after the Columbus convention the A.F.A. completed arrangements with the Institution of British Foundrymen for each association to have prepared annual exchange papers. Since that time the Association Technique de Fonderie de France and the Association Technique de Fonderie de Liège, the foundry associations of France and Belgium respectively, have consented to join in this arrangement, to promote greater friendship and respect of the foundrymen of these countries for each other.

F. J. Cook, of Rudge-Littley, Ltd., West Bromwich, Birmingham, England, presented the first exchange paper of the Institution of British Foundrymen, entitled "American vs. British Gray Cast Iron." Experience with poor quality of cast iron contained in many imported American machine tools, and reports appearing in American papers of failures of flywheels or of parts passing superheated steam have given the English foundrymen the impression that their gray cast iron is distinctly superior. While the methods of casting and breaking test-bars vary considerably in the two countries, it is possible to allow for these factors in making comparisons, and the author's works never produces metal testing as low as the electric furnace American iron described by George K. Elliott

having similar silicon content but much lower sulphur and phosphorus.

Englishmen give especial attention to the relative amounts of combined carbon and graphite carbon, seeking a microstructure which contains (under 1,000 magnifications) fairly large areas of well-defined, laminated pearlite partly inclosed by thick sheaths of cementite, and relatively small thin graphite flakes. Silicon, sulphur and phosphorus are not so closely considered in England; in Mr. Cook's opinion, the distribution of phosphorus is of far more moment than its amount. If, after deep etching with 20 per cent HNO_3 , bright, well-defined veins appear in a dark background (under 30 magnifications), the metal may be confidently expected to be far superior, even double in tensile strength, to an iron of the same chemical composition which appears with mottled, poor contrast after the same treatment. The author also expressed the opinion that this characteristic clear definition of phosphide existed in the pig by virtue of manufacture in slow-running furnaces with blast not over 900 deg. F., and persisted throughout subsequent melting.

NEW FRENCH ELECTRIC FURNACE

R. Sylvany, of the Association Technique de Fonderie de France, described an electric furnace employed at Jarville during the war for the deoxidation of converter metal. Using 1,000 kg. per heat, with 3,000 amp. direct current at 80 volts, 8 tons of metal was handled per 24 hours, or one heat in 3 hours. The furnace is a closed crucible, set in a tilting device. It is charged and poured through the top, normally closed by a tight fitting cover. Through this cover passes a sheathed carbon electrode, of cross-section about half that of the crucible. Direct current is used; this electrode is positive and becomes hollowed out into an efficient heat reflector. Refining appears to be quicker with direct current, possibly because free oxygen is immediately attracted to the carbon electrode and consumed.

A strong magnesia bottom is shaped into a trough, to contain the first molten metal which forms electrical contact with a bundle of pure iron wires at either side, imbedded in a mixture of magnesia and tar, and united at the ends to give good contact. These electrodes operate during the melting or preheating period. For refining, current is drawn from the bath near its surface by an upper row of electrodes consisting of a great number of 10-mm. wires set into the side lining. Use of many small metal conductors gives uniform distribution of the current to all parts of the slag layer, and it is rapidly heated to attain correct fluidity and intense chemical action.

EUROPEAN MALLEABLE IRON

Recognizing the evident superiority of American malleable iron, and its ability to compete with steel

castings, T. Levoz, of Auxonne, France, described efforts which the Europeans were making to improve their product. He ascribed the failures due to scoured molds to oxidized metal rather than superheated metal. Therefore it is essential that malleable shall be melted in furnaces capable of producing hot metal without forming ferrous oxide. Few European foundries have an output which warrants a reverberatory furnace; a cupola puts far too much oxygen into the metal; the crucible requires fine raw materials or excessively high temperatures. Germans have solved the problem by melting in the cupola and then blowing out the silicon in a side-blown converter. If a bottom-blown converter is used, ferrous oxides remain after the silicon has gone, and are reduced by carbon more or less promptly with the absorption of heat. Consequently the metal is chilled, it boils, traps slag, and liberates graphitic carbon at the moment of solidification even if it has been superheated sufficiently to pour a good casting. Using a side-blown converter and deoxidizing with aluminum, good results were obtained in France during the war.

Subsequently an electric furnace was added, making a triplex process. It is recommended that the cupola be provided with double row of tuyeres, thus separating the combustion zone from the fusion zone. A side-blown converter must be used, which ejects the slag as fast as it is formed and produces ferric oxide at the surface of the bath. An electric furnace then holds the metal for the necessary refining operations. Such hot, clean metal pours into castings of superior surface condition and even of very thin section, and can remain in the sand until quite cold. After annealing the physical properties approach those of cast steel.

One great advantage of the combination of equipment described is that the foundry possessing it can produce at will any kind of iron or steel casting.

STEEL CASTINGS

"Analysis Control in Acid Electric Steel Practice" was discussed by A. C. Jones, of the Electric Steel Co. of Chicago, who stated that off-analysis heats are often far more costly than imagined. A prolific cause of off-heats is frequent and unnecessary changes in furnace practice, trying to correct some fault which is not due to the quality of the metal. Continuous production of standard analysis by a carefully devised routine in a tight furnace will of course give the least trouble. Bridging over unavoidable delays is often done by charging heavy scrap into the hot empty furnace; this charge will lose more Si, Mn and C because it will be excessively oxidized during the wait. Especially avoid current interruptions during the melting-down period.

Low silicons are usually due to excessive oxide in rusty scrap or slow melting. The slag resulting is thin and watery, holding less than 30 per cent SiO_2 . It should be partly removed, some silica sand scattered over the bath, bringing the refining slag to 50 to 60 per cent SiO_2 , and the melt then thoroughly stirred. Finally add enough high-silicon pig to bring to analysis.

High silicon in just melted metal is recognized by very quiet metal when making a temperature test. It is often caused by reduction by carbon, if the melt contains more than 0.25 and is very hot. Excess silicon is best reduced by stirring in sufficient ore.

Carbon is seldom too high, unless there is electrode trouble. It can be lowered somewhat by an excessively siliceous slag, but the reaction adds silicon to the metal.

Oreing down may be resorted to, but at greater time, expense and wear on furnace. Carbon can easily be brought up by pigging at the end of the heat; or in case all other elements are high, by dipping the electrodes into the metal.

OPEN-HEARTH DESIGN

Willis McKee, of Cleveland, Ohio, described recent advances in open-hearth design, particularly in reference to the use of water-cooled equipment about the ports, which enables a "blow-torch" flame to be maintained consistently. He further recommends eliminating gas-regenerating chambers, locating the producers close to the furnace and introducing the gas into the air uptakes directly. Using the blow-torch principle, the air and gas thoroughly mix before issuing into the furnace. The combination is at a good temperature, because the air has a higher temperature than usual, since its checkerwork is heated by the entire waste gases from the furnace. Furthermore, the scheme saves a checkerworkful of gas at each reversal, and enables many economies to be effected in the construction of the furnace.

Non-Ferrous Sessions

PHYSICAL PROPERTIES OF CARTRIDGE BRASS

C. Upthegrove and W. G. Harbert, of the University of Michigan, presented a brief paper of the above title giving data to show that the differences in temper in brass persisted after cold-working. For instance, a coarse-grained brass resulting from a high anneal was softer than a fine-grained, low-anneal brass, and remained softer after equal amounts of work had been done upon them. (Heavier reductions naturally increase the hardness, but did not change the relationship.) These hardnesses persist and even increase slightly upon annealing at 200 deg. C., whereupon recrystallization sets in, progressing most rapidly for those having heavy cold-work, and all differences in hardness disappear after annealing to 550 deg. C., when a hardness of 60 Brinell (500 kg.) appears for this analysis—68.5 Cu, 31.5 Zn. Higher anneals cause this figure to fall slightly. (Brinell 43 at 750 deg. C.)

ELECTRICAL PROPERTIES OF NICKEL AND MONEL WIRES

Supplementing data published in Bureau of Standards Circular 100, Messrs. Hunter, Sebast and Jones, of Rensselaer Polytechnic Institute, showed that nickel wires of lowest resistance (specific resistance 7.55 to 7.60 microhms per cm. and temperature coefficient of 0.0056 ohm per degree C. per ohm at 20 deg. C.) may be made in limited amounts by slitting a sound cathode sheet and rolling it into a wire.

If any quantity of such material is desired, the purest metal must be melted by having a hot vacuum furnace so designed to receive a charge of, say, 5 lb., and melt it very quickly so as to pour within a very few minutes. Even then about 0.75 per cent of manganese must be used to make a sound casting. Under such circumstances the specific resistance of 9.12 with temperature coefficient of 0.0049 may be had. The authors also publish curves comparing the relative resistance of electrolytic nickel, grade A, C and D, and Monel metal at temperatures varying from 20 to 1,000 deg. C. As would be expected, the specific resistance rises and the temperature coefficient falls with growing impurity. Furthermore, the curves show definitely the reversible

magnetic transformation at about 360 deg. C. to be lowered progressively with increasing impurities, arriving at 93 deg. C. for Monel. Magnetic releases operating at any temperature between those limits could apparently be constructed of nickel alloys of varying purity.

EMBRITTLMENT OF COPPER WIRE ON ANNEALING

Another evidence of the extreme sensitivity of high-grade metal to foreign substances was cited by T. S. Fuller, of the General Electric Co. He found that if high-conductivity copper wire was packed in sea sand in a closed iron pipe and annealed 1 hour at 800 deg. C. in an electrically heated furnace, it was rendered so brittle it would break on a right-angle bend. The trouble was thought to be due to reduction of CuO by hydrogen or carbonaceous gas derived from the steel or organic matter in the sand, whereupon some resulting gases of slow diffusibility accumulate in sufficient volume to wedge the grains apart—at least at the surface, the most dangerous region. Oxygen-free copper was not made brittle. Neither was commercial tough pitch wire, annealed in Al₂O₃ in a porcelain tube, or annealed in calcined sand in an electrolytic iron tube.

N. B. Pilling, of the Westinghouse Co., pointed out that copper may be deoxidized in molten c.p. salt, by H₂ derived from the dissociation of traces of water of crystallization. In fact it is at times extremely difficult to maintain non-reducing atmospheres. At other times copper does not seem to be so sensitive to its surroundings, as witness the everyday performance of brazing operations.

TECHNICAL CONTROL IN THE FOUNDRY

E. H. Dix, Jr., described the foundry at McCook Field, Dayton, Ohio, where all the castings for experimental aircraft parts are made and where the design and alloys are perfected before contracts are let for larger quantities. Their furnace equipment consists of stationary and tilting crucible furnaces, and a high-frequency induction furnace for melting refractory alloys or hardeners. Temperatures during melting and pouring are controlled carefully—base metal thermocouples protected by iron tubes are used in aluminum alloys. For quick readings iron-constantan "pyods" are useful. Bare No. 6 gage chrome-alumel wires spread wide apart may also be used—they waste away slowly, but are easily re-welded, and the metal lost does not harm the alloy. In brass or bronze a chromon tip protecting tube has been very satisfactory. Following is a table of temperatures used for the small castings used in aircraft:

Alloy	Melting Point Liquidus, Deg. F.	Maximum Furnace Temp., Deg. F.	Pouring Temp., Deg. F.
Cu 8, Al 92.....	1,148	1,400	1,200 1,300
Cu 10, Al 90.....	1,130	1,400	1,200 1,300
Cu 85, Sn 5, Zn 5, P 5.....	1,780	2,000	1,950
Cu 88, Sn 10, Zn 2.....	1,825	2,200	2,050
Cu 80, Sn 10, Pb 10.....	1,735	1,950	1,900
Cu 60, Zn 37+3 Hardener.....	1,600	1,800	1,700 1,750

An extended study has been made in order to locate the correct way to place a test coupon or to cast a test-bar so that it will really represent the condition of the finished casting. Separately cast test-bars have been decided upon; thereby all disputes as to methods of gating may be avoided. In correlating the properties given by such standardized test-bars to those of important castings it is the practice to pour several full-sized castings from the same heat, and those cast-

ings are tested as nearly as possible under the same stresses as they will receive in service. Many different heats are cast, varying the pouring conditions and the disposition of gates.

Microscopic examination of all heats is made. All the data—pouring conditions, physical tests, chemical analysis and metallography—are then collected on one card and filed. With a sufficient accumulation of such data, it is thought that in time very definite and valuable indications may be derived from the microscopic examination.

METALLIC OXIDATION AT HIGH TEMPERATURES

One of the most important papers of the meeting was presented by N. B. Pilling and R. E. Bedworth, of the Westinghouse Co., in that it gave a new and stimulating idea on the subject of corrosion. The authors confine their attention to oxidation by atmospheric gases at high temperatures—i.e., temperatures where the solid phases participating in the reaction diffuse with high speed, and this diffusion has become the dominant force.

In the first place, noble metals are separated from base metals by the fact that the dissociation pressure of the oxides of the noble metals are equal to or above atmospheric pressure at temperatures below the melting point, whereas the corresponding values for the base metals are extremely minute. But the character of the first-formed oxide furnishes a further classification of base metals: If the layer of oxide formed takes up more space than the volume of metal which was oxidized to produce it, the oxide layer forms a tight fitting, solid sheet, thus impeding further oxidation. Computations made on this basis for twenty-three metals separate those which oxidize readily from those which do not. Some of the former—having a porous or cellular oxide structure—have been shown to oxidize at a uniform rate until all the metal has vanished. Compact oxide coatings, however, have been shown to grow at a rate which varies inversely as the thickness—i.e., "the speed of the reaction is not determined by any property of the metal at all, but by some combination of physical properties of the oxide." These properties of the oxide coatings are discussed, and an equation derived between the rate of oxidation and the temperature which closely agrees with experimental values.

LEADY BRONZE, SO-CALLED "ENGINE BRASS"

R. E. Lee and F. B. Trace, of Allegheny College, told in an interesting manner of an investigation undertaken to determine proper foundry practice to produce Cu: Sn: Pb alloys containing up to 30 per cent Pb without "segregation"—i.e., with a structure simulating that of a eutectic—despite the fact that the system is not truly eutectiferous and that 15 per cent is sometimes spoken of as the limit for lead in such alloys. Sometimes high lead is handled by addition of nickel or other "carrier."

It was found, however, that if the melt was superheated to 2,000 deg. F. (or 200 deg. higher if all virgin metal was used), deoxidized by phosphor copper and skimmed, the metal, which formerly tended to separate into two immiscible layers, becomes capable of more intimate mixing or even is mutually soluble. The charge is quickly dumped into an oversize pot, which gives the necessary stirring, and also chills it to 1,800 deg. F., whereupon it is poured into firmly rammed sand molds, and cooled in the mold. When a 5x10½-in.

bearing is made in this way it possesses high strength, and a fracture shows a uniform light color, free from dark "segregated" spots, even though it contains no nickel. Well-selected scrap may form all the charge except necessary additions to bring to analysis.

MELTING FURNACES FOR BRASS AND ALUMINUM ALLOYS

A posthumous paper by T. H. A. Eastick emphasizes the fact that no "best" furnace or fuel existed for copper alloys. N. K. B. Patch, of the Lumen Bearing Co., agreed emphatically, saying that successful melting is a combination of fuel, furnace and brains, and if sufficient brains are available, almost any furnace will do. Therefore the character of the available help is as important as the first cost of a furnace or the fuel cost. The electric furnace is of considerable advantage in holding down melting losses in certain alloys which must be poured very hot, but often the open flame furnace will do just as well if the atmosphere is properly maintained. Jesse E. Jones, of the Westinghouse Co., recommended that large foundries diversify their equipment and thus be ready for any emergency, citing an incident where Mr. Marconi provided three independent sources of current to make sure that certain demonstrations would not fail for lack of power. Two sources did fail, but the third worked!

Aluminum foundrymen were unanimous in saying that a satisfactory furnace of large capacity was yet to be designed. When this arrived it would probably be an electric furnace, because the atmosphere is most easily controlled, although present designs left something to be desired. Robert J. Anderson, of the Bureau of Mines, in presenting his paper entitled "Aluminum and Aluminum-Alloy Melting Furnaces," recommended for sizable foundries an open flame furnace, barrel shaped, about 12 ft. long by 6 ft. in diameter. This should be operated with close temperature and atmospheric control, and additions of pig made periodically to match pourings, so as to maintain a molten bath at all times.

Apparently the iron pot holding 400 lb. of Al is widely used, even by large foundries, and many members spoke of methods whereby the life and performance could be bettered. Mr. Anderson said that forty-seven heats per pot was the average of many reports in his hands, and that the chemical composition of the iron did not seem to have much influence. A sound gray iron, preferably low in carbon, silicon and phosphorus, was as good as or even better than more expensive high-silicon irons. Many pots would fail in a very few heats, but that was ordinarily due to defective molding practice. W. M. Weil, of the National Smelting Co., said it was perfectly possible to get 300 heats from an iron pot if properly cared for. In the first place, the furnace setting should be deep, with at least 1 ft. for a combustion chamber below the pot. The burner is placed tangentially at the very bottom, so that the swirling flame envelops the pot without striking it. Furthermore the burner should be operated with a very slight deficiency in oxygen, so that scaling would not waste the pot and obstruct the heat flow. The inside of the pot is sand-blasted during the night and painted with lime and silicate of soda. It was further recommended that the pot be made somewhat deeper than the diameter, to reduce the surface of the bath.

John A. Lange, in a paper, "Melting Aluminum for Rolling Into Sheet," described the development of a

quick melting furnace which on long campaigns has given the following performance:

	Charge		
	Virgin Metal	Clean Mill Scrap	Oily Stamping Scrap
Melting loss.....	9%	16%	31%
600 b.t.u. gas per 1,000 lb. Al.....	2,500 cu.ft.	2,800 cu.ft.	2,900 cu.ft.
Wt. of charge.....	1,100 lb.	850 lb.	850 lb.
Time to melt.....	23 min.	23 min.	23 min.

This furnace is also shaped like a drum, the chamber being 33 in. in diameter and 96 in. long, and tilts when pouring. One end has a 9-in. pouring opening, while the opposite has an 18-in. charging and skimming opening, closed by a swinging door, reducing the opening to 9 in. for the burner. Automatic air-gas mixing valves were installed. The drum makes a complete revolution in 4½ minutes, a feature which promotes uniform and rapid melting. The lining is of special 5½-in. low-silica firebrick, which withstands 10,000 heats.

About 1 lb. of cryolite is charged with the cold charge, and when melted about 4 oz. of ZnCl₂ scattered over the bath and the dross immediately skimmed. Temperatures of the furnace atmosphere should not exceed 1,800 deg. F. Metal is poured at 1,250 deg. F. into cast-iron ladles containing ½ teaspoonful of ZnCl₂, skimmed and poured into open-top slab molds about 12 x 18 x 1½ in.

Natural-Gas Gasoline in 1921

The output of natural-gas gasoline in 1921 increased 23 per cent over that in 1920, but the market for natural-gas gasoline was rather unstable because of the depression in the petroleum industry, according to a preliminary statement of the United States Geological Survey. The statement is based on incomplete returns from the producers and is subject to revision. Seventy-five per cent of the output was recovered at compression plants and the remainder at absorption plants. The average daily production was 1,297,000 gal., as compared with 1,054,093 gal. in 1920. The average production per plant in 1921 was 408 gal., compared with 333,400 gal. in 1920.

A decrease in the value of natural-gas gasoline was naturally produced by the breaking of the market due to the depression in the petroleum industry. The total value in 1921 was about \$6,000,000 less than in 1920. The prices received by the producers declined to 8 cents a gallon, and the average price as computed from the total output in 1921 was 5 cents less than in 1920. Although the output was greater, 5 per cent less gas was treated, so that the plants showed increased efficiency in 1921. The average yield of gasoline per thousand cubic feet of gas was 0.2 gal. greater in 1921.

Texas has become an active field for the natural-gas gasoline industry, with an output in 1921 that was 172 per cent greater than in 1920 and occupied second place in the list of producing states. California also increased its production, but West Virginia, which was second in rank, showed a decrease and occupied fourth place.

The following figures are for unblended natural-gas gasoline. It is understood that blending with higher grade gasoline is essential before the product can be used for motor fuel.

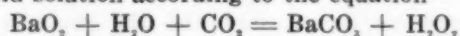
	Compression and Vacuum Process		Absorption Process	
	1920	1921	1920	1921
Number of plants.....	967	957	187	204
Gasoline produced, gal.....	281,131,973	355,346,900	103,611,949	118,311,600
Average price per gal., cents...	17.9	13	20.8	17
Estimated volume gas used, 1,000 cu.ft.....	112,887,802	134,817,400	383,543,150	344,609,200
Average yield of gasoline per 1,000 cu.ft., gal.....	2.49	2.6	0.27	0.4

Hydrogen Peroxide—A Novel Process for Its Manufacture

BY H. A. DOERNER

THE following experiments were carried out at the plant of the Chemical Products Co. in the year 1916 and the results of the work are embodied in a patent owned by that company. At that time the company was manufacturing hydrogen peroxide, using the usual phosphoric acid method, and was having difficulty in obtaining a supply of phosphoric acid of satisfactory quality. There were impurities in most of the acid then obtainable, which resulted in an inferior product. The expense of purifying the acid would have been serious and the plant was not equipped to do it. This situation led to an attempt to find some substitute for the phosphoric acid.

Since the barium salt formed by the action of the acid on barium peroxide must be separated from the hydrogen peroxide solution produced, it is evident that an acid which gives an insoluble barium salt must be used unless distillation is employed. Sulphuric acid cannot be used except in conjunction with phosphoric, because free sulphuric acid causes decomposition of the hydrogen peroxide. Carbonic acid is the only other cheap acid which forms an insoluble barium salt. Text-books on chemistry state that hydrogen peroxide may be prepared by slowly adding barium peroxide to a carbonic acid solution according to the equation



The use of carbon dioxide would effect three important advantages:

1. No impurities would be introduced by the acid.
2. The byproduct, barium carbonate, is more valuable than the barium sulphate produced by the usual method.
3. Carbon dioxide is cheaper than the phosphoric and sulphuric acids required by the usual method. Since the cost of liquid carbon dioxide as placed on the market is largely due to the expense of liquefying and to the overhead on costly containers, this economy can be greatly increased by operating the process near to a source of carbon dioxide, and using the gas at comparatively low pressure.

EXPERIMENTAL TESTS ENCOURAGING

Preliminary experiments in the use of carbon dioxide were not encouraging. The gas was bubbled through an emulsion of barium peroxide in ice water. The hydrogen peroxide decomposed nearly as fast as it was formed. Slowly adding the barium dioxide to ice water through which the carbon dioxide was bubbling gave only slightly better results. Nothing approaching commercial requirements in recoveries or strength of product could be obtained by the method as described in textbooks.

In comparing these experiments with the commercial method it seemed probable that the failure of the former was largely due to the fact that an excess of carbon dioxide could not be maintained because of its slight solubility and slow absorption in water. An excess of barium peroxide, even if local, will cause decomposition and loss of hydrogen peroxide as shown by the reaction



It seemed reasonable to expect that if barium peroxide were slowly added to a solution of carbon dioxide which was maintained at a relatively high concentration

by means of an atmosphere of carbon dioxide under high pressure, a condition analogous to that in the usual method would then exist and good results be obtained.

We were unable to devise an experimental apparatus which would accomplish the above-mentioned conditions without involving a greater expense than would be permitted. The difficulty lay in the problem of slowly feeding the barium dioxide into a chamber having a high internal gas pressure. So we decided to see what results could be obtained by treating an emulsion of BaO_2 (barium peroxide) and water to a high pressure of carbon dioxide gas. To this end we made a reaction chamber of pipe fittings consisting of a 2-in. sleeve closed at one end by a cap and connected at the other end by means of a bushing and a $\frac{1}{4}$ -in. pipe to a cylinder of carbon dioxide. The chamber was charged with an emulsion of barium dioxide and water, tightly closed, cooled to 4 deg. C. by an ice pack, connected to the cylinder of carbon dioxide and the pressure turned on to 80 lb. pressure for 20 minutes, during which time the reaction chamber was kept agitated in order to facilitate the rapid absorption of carbon dioxide.

The completion of the reaction can be judged by the fact that during the reaction carbon dioxide must be continuously supplied in order to maintain the pressure, but when the reaction is completed the pressure will remain constant without such addition. The pressure was then released, the reaction chamber opened, the charge quickly filtered and tested to determine the percentage of hydrogen peroxide recovered. This was calculated as follows:

A weighed portion of barium peroxide in a measured quantity of water will give a hydrogen peroxide solution of definite strength if perfectly converted. The ratio of the actual strength (as determined by titration with permanganate) to the theoretical strength gives the percentage recovery. A large number of such tests were made with various conditions of time, pressure, amount of charge, etc. The results ranged from 50 to 80 per cent recovery. They indicated that the carbon dioxide was absorbed as rapidly as the barium peroxide could dissolve, thus maintaining an acid condition even in the presence of an excess of barium peroxide.

THE COMMERCIAL UNIT

These results were so encouraging that it was decided to proceed at once to an apparatus of commercial size, as the problem of feeding the barium peroxide into the reaction chamber could be worked out more easily than in a smaller device. A 6 x 6-ft. vertical cylindrical iron tank was provided with a mechanical stirrer, a false bottom of canvas filter cloth supported by a wooden frame, and an outlet pipe with valve under the false bottom. Access to the interior was obtained by a man-hole having a tightly fitting cover. Valve-controlled inlets for compressed air, carbon dioxide and barium peroxide emulsion were provided, also pressure gage, small outlet cock for taking samples and a thermometer well.

Our most difficult problem was to introduce the barium peroxide into the pressure tank, and we tried a number of different pumps without success. We also tried to feed the barium peroxide as a dry powder through a cock in which a rotating plug provided with a small depression or pocket was substituted for the ordinary plug having an opening clear through it. It was hoped that as the plug rotated the barium peroxide

would fall from the hopper above into the depression in the plug and be carried around and dropped into the reaction chamber. The device failed because it was impossible to prevent excessive leakage of gas and also because the barium peroxide powder refused to drop consistently into and out of the pocket of the rotating plug, due to its cohesive nature.

We also made an emulsion of barium peroxide with water and tried to pump it into the reaction chamber with several different types of pumps. None of these pumps could be kept in operation for any length of time due to the tendency of the barium peroxide to settle out in the valves and thus prevent them from operating. These deposits would set into a hard cement, and this tendency was increased by any carbon dioxide which might force its way back into the pump system.

SOLUTION OF FEEDING PROBLEM

This difficulty was never completely overcome, but we finally devised a simple single-stroke plunger pump using ordinary brass check valves, which operated fairly well and could be cleaned easily and quickly when necessary. I believe that a more satisfactory method would be to emulsify the barium peroxide in a small auxiliary pressure tank and permit it to run by gravity into the reaction chamber after equalizing the pressure in the two. It would be necessary to use some other means than a direct application of the carbon dioxide atmosphere for equalizing the pressure, because reaction would then take place in the emulsion chamber and the hydrogen peroxide formed would be destroyed by the excess of barium peroxide.

Our procedure was as follows: A mixture of about equal weights of ice and water was put into the reaction vessel, all openings closed, the agitator put in operation and carbon dioxide admitted to about 60 lb. pressure.

A 100-lb. batch of barium peroxide emulsified in 200-lb. ice water was prepared in a small mixing tank and pumped into the reaction tank at a rate which required from 2 to 3 hours to handle four batches, a complete run. From time to time samples were withdrawn and tested for percentage of acidity, and the pump speed and carbon dioxide pressure were regulated accordingly. We found that the best results were obtained at about 0.2 normal acidity, alkalinity and high acidity both causing decomposition and loss of hydrogen peroxide.

Irregular action and sometimes complete failure of the pump caused by barium peroxide settling in the valves and pipes frequently caused the acidity to fluctuate to a dangerous degree. Decomposition would then commence and the additional heat thereby generated would consume the ice. This condition would be indicated by a rise in temperature, and it was then necessary to filter the charge as quickly as possible in order to prevent a total loss.

The decomposition of H_2O_2 in alkaline solution could be accounted for as explained above, but we were doubtful concerning the reason for the harmful effect of high acidity. One theory advanced was that iron from the apparatus was brought into solution, causing catalytic decomposition. An interesting fact is that the barium carbonate precipitate was granular when formed at the proper acidity, but flocculent when either high acidity or alkalinity existed.

YIELDS OBTAINED ON LARGE UNIT

Our average recoveries were low, 80 to 85 per cent, which was due mostly to faulty mechanical and thermal

control. On several runs we obtained recoveries as high as 95 per cent, which compares favorably with those obtained by the usual method on the same grade of barium dioxide. We were treating the lower grade of our barium peroxide production and we later heard that the Eastern manufacturers who purchased the bulk of our supply obtained very poor extractions on certain lots. Slow filtration also accounts for considerable of our losses in many instances.

After filtering the charge, the barium carbonate was washed several times with water and the washings were used as an initial solution for the next run. The main filtrate still contained some barium in solution as bicarbonate, most of which was precipitated with sulphuric acid. The final trace of barium was precipitated with phosphoric acid, a slight excess being used. After again filtering, the hydrogen peroxide solution was run to storage tanks and air bubbled through it to remove carbon dioxide.

BAFFLING INSTABILITY: "THE HOME BREW PROBLEM."

The hydrogen peroxide so produced conformed to all the tests required by the trade, both as to purity and stability. Some impurities commonly introduced by the mineral acids were completely absent, and we found no other brand which excelled in purity. For several months it was put on the market with complete confidence in the belief that it was of superior quality. Then reports of disaster began to arrive. I use the word report advisedly, because a considerable portion of our product decomposed and the pressure of the liberated oxygen blew the corks out of the bottles.

It was a very baffling situation. Our chemical tests revealed no impurities which could cause the trouble, and most baffling of all was the fact that samples which gave a satisfactory stability test were not stable. The stability test consists in heating a flask of hydrogen peroxide on a water bath and measuring the rate of decomposition at definite temperatures. The presence of percarbonic acid, which would be destroyed during the first stage of the stability test, might account for the facts. Another theory is that minute traces of metal from the apparatus were held in solution, but the cause has never been definitely proved. We kept samples of each run and many of the samples showed no appreciable loss after many months, so we concluded that the cause of instability could not be an inherent factor of the method.

Market conditions caused us to discontinue the manufacture of hydrogen peroxide before the question of stability was solved. It is the writer's opinion that enameled ware equipment designed to give good mechanical and thermal control would solve the problem of stability both during and after manufacture, and that the process is superior to present methods.

Texas Leads in Oil Refining

The extent of the growth of the refining end of the petroleum industry in Texas is shown by the fact that there are now 109 oil refineries in the state, 63 of which are on the active producing list at the present time, with aggregate production of 345,150 bbl. per day. In addition, there are 9 refineries in course of construction. Texas now stands as the leading state of the Union in this branch of the industry, and is third in point of production of crude petroleum, with a record of 105,209,500 bbl. in 1921.

Some Causes of Rejections in Boiler Tubes

BY H. G. CARTER

IN THE manufacture of boiler tubes very low-carbon solid round billets are charged into a furnace and heated to a good forging temperature, which is in the vicinity of 2,100 deg. F. Upon being brought to the proper heat the billets are put into a piercing machine, where the center is punched out, the solid billets being thus converted into rough seamless tubes. These tubes are permitted to cool (usually by permitting them to roll into a tank of water) and sent to a pickling room, where the scale is removed, after which they are taken to a draw-bench and the ends tapered for a "tong hold." They are then drawn through a die and over a mandrel or plug. This process is repeated until the desired outside diameter and wall thickness is obtained, the tubes being given several process annealings and picklings during the drawing operations. When the desired size has been reached, the tubes are given a final annealing, straightened, cut to length and presented for inspection and testing.

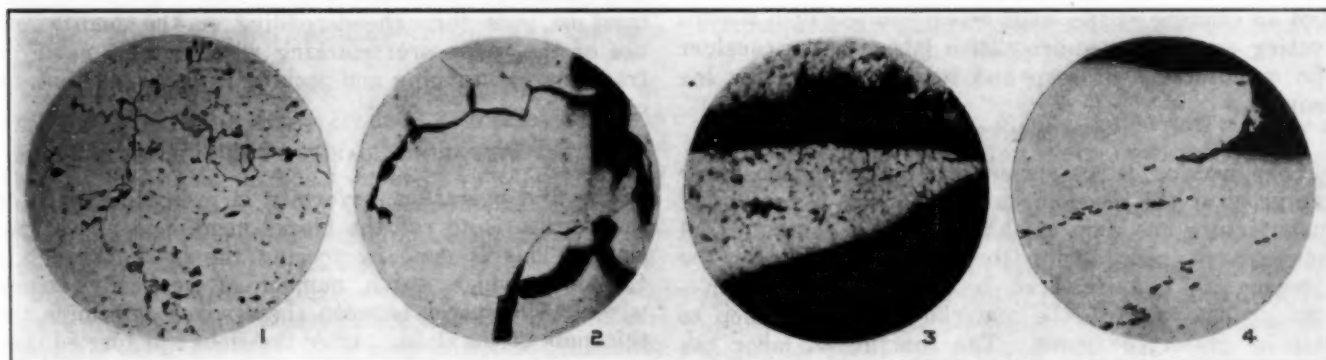
Tubes are rejected chiefly on account of the following defects: crookedness, non-uniformity of wall thickness, seams, tears, excessive scale and brittleness as shown by expanding, flattening or hydraulic pressure tests.

defect which generally appears in the piercing machine or at the draw-bench. Burning can usually be traced to the heating for piercing. Fig. 2 shows an extreme example of burnt steel; here the grain boundaries have opened and are lined with iron oxide. Other examples of burnt steel have been observed, not sufficient to oxidize the grain boundaries to a visible extent, but the billet was nevertheless so brittle that drawing was impossible. Of course burning may take place in the steel mill, but this does not usually happen.

Lap seams are the usual type found in seamless tubes and are caused by folding excess metal over upon itself during the first pass in the drawing process, which is subsequently drawn down to a thin fold but not united to the metal beneath it. Fig. 3 shows such a seam.

Tears occurring during the drawing process and cracks resulting from hydraulic tests are usually traceable to dirt chains and ghost streaks. Fig. 4 shows a crack from a fracture following a dirt chain. Cracks often follow a ghost streak (band of metal which remains bright after etching with Stead's reagent). Excessive dirt in steel is usually found to be located within these ghost streaks.

Rejections due to crookedness, non-uniformity of wall thickness, excessive scaling, brittleness caused by overheating in annealing and burnt steel (excepting steel burnt at the steel mill) are preventable, unnecessary and constitute a very large part of the total rejections.



FIGS. 1 TO 4—STRUCTURE OF DEFECTIVE BOILER TUBE

Fig. 1—Coarse grain. Etched with HNO_3 . $\times 60$

Fig. 2—Burnt steel. Unetched. $\times 30$

Fig. 3—Lap seam. Etched with HNO_3 . $\times 60$

Fig. 4—Crack following dirt string. Unetched. $\times 60$

Rejections due to crookedness and brittleness are usually temporary, because crooked tubes are put through a straightening machine and the brittle ones reannealed and both returned for inspection.

Tubes that are rejected because of non-uniformity of wall thickness are redrawn to make tubes of a smaller size and after annealing and straightening are submitted for inspection.

Tubes with seams and tears are absolutely rejected and are either scrapped or sold for low-grade tubing for uses such as electrical conduits.

Let us look into the cause of some of these rejections.

Brittleness is usually the result of large grains caused by overheating during the annealing, which is the result of carelessness on the part of the furnace man or is caused by poor furnaces of improper design or by faulty pyrometers. Fig. 1 shows a structure which failed the expanding and flattening tests due to excessive grain size, but was salvaged by reannealing, which produced a much finer structure.

Another cause of brittleness not usually discovered in the inspection department is due to burnt steel, a

They are the result of carelessness, incompetency or the lack of intelligent supervision of those in charge of the departments in which they originate.

Rejections caused by dirt, gas holes, ghosts, segregations and burning at the mill may be classified as unavoidable rejections, except that they can be greatly reduced by purchasing a good grade of steel and by making a complete trial run of a few bars before starting the entire shipment through the mill.

Waverly, Mass.

The Katathermometer

The katathermometer is an instrument contrived by Dr. Leonard Hill, an eminent English physiologist. Dr. Hill, after exhaustive experiments, concluded that the rate of cooling of the human body was the controlling factor in determining comfort or discomfort. The katathermometer measures the rate of cooling of the body. A preliminary study by the Bureau of Mines indicates that the instrument will be useful for making determinations of comfort conditions in coal and metal mines.

Handling the Finished Products of Industry—III

General Consideration of Soap Manufacture—Why It Is Profitable to Use Mechanical Methods in Handling Finished Soap—Two Examples From Existing Soap Factories, Showing Amount of Non-Productive Labor Eliminated in Each Case*

BY GRAHAM L. MONTGOMERY

HANDLING the finished product—from the time the last true manufacturing process is completed until the article passes out of the ownership of the maker—often costs more than all the other charges which the work must bear, as pointed out in the first article of this series. This is particularly true in an industry where the process of manufacture is one entailing but little labor, an industry essentially adapted to production in bulk. In such an industry the operations necessary to prepare the finished product for the market are the operations entailing most of the non-productive labor and are responsible for most of the labor cost which enters into the sale price. The reduction of the cost of this non-productive labor therefore presents the possibility of increase in profits or reduced selling price. As an illustration of such an industry and an example of the steps which can be taken toward cutting down the non-productive labor, let us consider the manufacture of soap and its preparation for the market.

SOAP MANUFACTURE

Soap making is an ancient art. During the many centuries of the development of this art a routine of manufacture has been established which eliminates all unnecessary labor during the process. Whatever the type of soap manufactured, be it soft or hard soap—cold or hot process—the material flows from step to step by gravity or pump. The function of labor has been reduced to the control of the process and there is little possibility that much more reduction in labor can be brought about.

In handling the raw material, the field for econ-

omies is again small. Today this raw material is largely liquid and its handling is extremely simple and inexpensive. In case a hard fat forms the basis of manufacture, it is first melted and can then be handled as an oil would be. The savings possible in this part of the work are at best slight, so slight that their study promises little immediate reward.

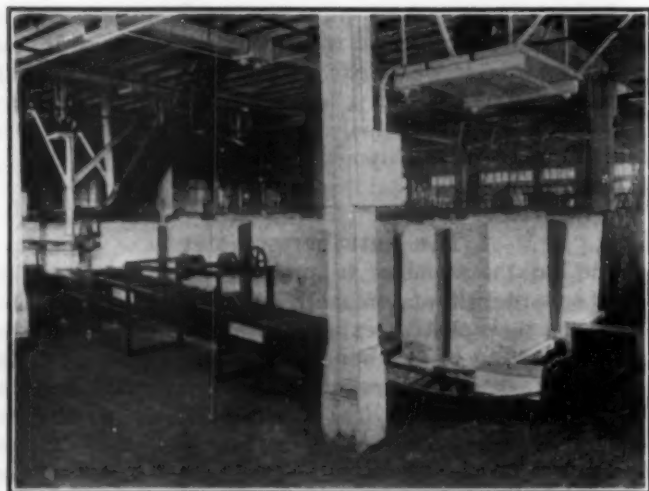
The last operation in the manufacture of the soap leaves it in the large block in which it has set in the frame. A number of these blocks are shown in the accompanying illustration. As these blocks stand, they are finished soap and no further changes need be made in their constitution. But they are not in marketable form. They must be made into cakes of a size suitable to the uses and the buying habits of the consumers who will ultimately purchase them. Other operations that must be gone through—depending on the quality and use of the soap—are: marking with suitable name or trade mark, wrapping and packing in boxes, cartons, or cases.

PREPARING SOAP FOR THE MARKET

The first operation performed in preparing soap for the market is to cut the blocks mentioned above into slabs. This is done by forcing the block through a frame in which are a number of vertically strung wires. The spaces between these wires determine the thickness of the slabs. After the slabs are formed they are put through the cutting machine. Sometimes this machine only cuts the slabs into strips and then these strips have to be put through another cutting machine which cuts them into bricks of soap of a proper size to form the desired cake. Usually these two cutting operations are done on one machine, the slab being forced through the strip-cutting wires and then all the strips together being moved at right angles through the brick-cutting wires.

The bricks of soap resulting from the last operation are placed next in the press. This takes each brick separately and presses it into the desired cake-form. At the same time the names, trade marks, ornamental designs or other devices are imprinted on its surfaces. Some grades of soap contain too much moisture when in the brick form and it is necessary to dry or cure them before they reach the press. If space is available and cheap, this can well be done by the atmosphere in any well-ventilated and dry room. It is, however, more usual to place the soap bricks in drying rooms, where the drying is expedited and kept under control through the use of artificial heat.

After the cakes leave the press, the next operation generally consists of placing the wrapper on them. This is now usually done in automatic machines, although in some cases where the cake is of a fancy shape it is still customary to do the wrapping by hand. From the



BLOCKS OF SOAP FROM FRAMES WAITING TO GO THROUGH SLABBER

*Article I of this series appeared in CHEM. & MET. ENG., vol. 26, No. 18, p. 828, May 3, 1922. Article II appeared in vol. 26, No. 19, p. 885, May 10, 1922.

wrapping department, the soap passes to the packing tables. Here it is packed in some sort of container, depending on the quality of the soap and how it is marketed.

LABOR USED IN PREPARING SOAP FOR MARKETING

The routine of preparation described above is not the only one used and various manufacturers follow different methods, according to the kind of soap they make and the requirements of their market. It is, however, general enough to serve as a pattern, any variations which occur being easily interpreted in the above terms.

The labor used in these operations consists of that needed to perform the actual cutting, pressing, wrapping and packing; and that used in moving the soap from operation to operation. Of the former, it is safe to consider the cutting and pressing as productive, since these two processes actually enhance the market value of the soap. The wrapping and packing, together with all the handling, are non-productive.

As stated above, there is little opportunity to cut down the productive labor in soap making. The use of automatic machinery for cutting and pressing is quite general. In the exceptional cases where machines are not employed for this work, it is possible to effect a considerable labor saving by adopting these machines. And in almost all cases where drying rooms are employed between these two operations there is handling in connection with these rooms which could easily be eliminated. That, however, actually comes under the non-productive classification.

The non-productive labor in soap making is, as we have seen, almost entirely confined to that expended in handling the finished soap. Of late years there has been a creditable introduction of automatic wrapping machinery and some plants have also installed more or less complete mechanical handling equipment from the presses onward to the packing tables. The following two examples from actual working installations will serve to show what has been accomplished to date and perhaps point the way to a more complete realization of the savings to be obtained from such improvements.

Before passing to these examples it is well to point out that no attempt is here made to criticize the manufacturing methods in vogue throughout the soap industry. It is no doubt possible that improvements which will lessen the cost of this manufacture can and will be effected as time goes on. But while the present processes and methods hold their favored place with manufacturers, and assuming no immediate, decided drop in cost of raw materials or fixed charges, it is to the reduction of the non-productive labor cost to which we must look for lowered production costs and increased efficiency.

A PLANT FOR MAKING CHEAP SOAP IN LARGE AMOUNTS

Let us take for consideration first a plant where the total bulk of product is large—where the product, while divided into two or three grades, is really all about the same, and where the selling price must, in accordance with the nature of the product, be low. In the first place, in making soaps of these grades, the methods employed by all manufacturers in the actual manufacture are essentially the same. The raw materials will in most cases be obtained by all the competitors at about the same price. The amount of labor is about the same for any of these plants, diminishing propor-

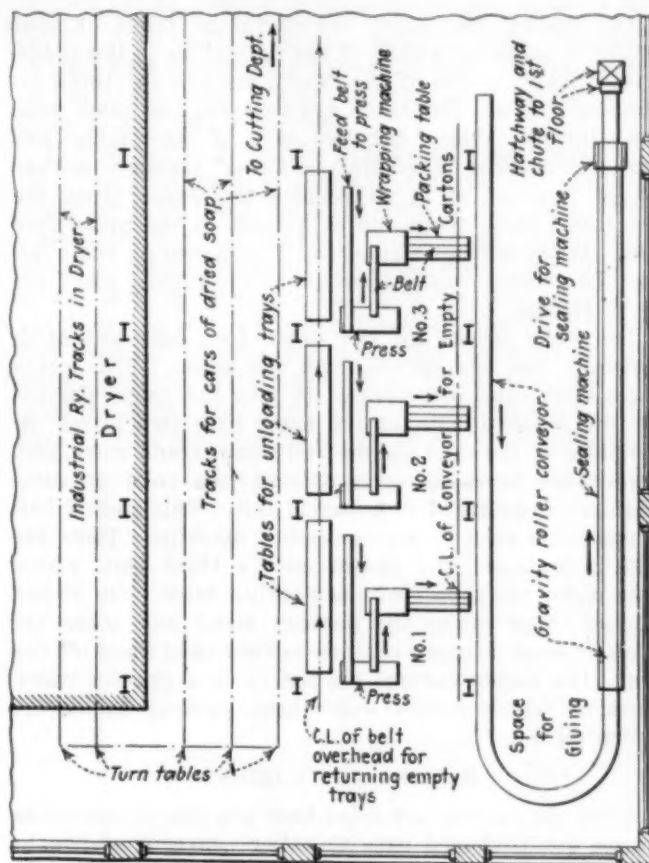


FIG. 1—PLAN OF HANDLING IN PRESSING, WRAPPING AND PACKING DEPARTMENTS

tionately per ton output as this output increases. This fact makes it desirable for every manufacturer to increase the bulk of his sales and hence the relative output per unit of productive labor cost in order to compete with others in the field. However, most of the producers have sufficient bulk of product to meet this condition successfully and if they desire to reduce their total production costs so that they may increase their profits or lower their prices they must look to some other means. A number of plants of this type have found the solution in the almost complete adoption of mechanical equipment for the handling and forming of the soap between the point where the frame is stripped and that where the soap is loaded out of the plant.

The sketch marked Fig. 1 shows a part of one of the most complete installations of this type of equipment so far put in. Here the blocks of soap from the frames, shown in one of the accompanying illustrations as standing on the wheeled bottom of the frame after the frame-sides have been removed, are put through a slabbing machine. This cuts the blocks into slabs having the cross-sectional dimensions of the original block for length and breadth and thickness enough to meet the requirements of the finished cake. The slabs are then put through the cutting machine, which, automatically in two cuts, produces bricks of soap of the proper size to be pressed into the finished cakes.

These bricks are placed by hand on slatted wooden trays as they come out of the cutter, about 100 bricks to the tray. The filled trays are stacked ten high on wooden platform industrial railway cars, making 1,000 cakes per car. After a car receives its full load of trays, it is pushed down the track and into the drier. Here the soap is dried sufficiently so that it is stiff enough for pressure into the desired cakes.

On leaving the drier, the careful of trays of soap bricks is taken by means of the turntables in the industrial railway to one of the tracks marked for this purpose on Fig. 1. The trays are removed and piled upon the adjacent tables. Between each of these tables and the belts marked "Feed Belt to Press" stands a worker whose function it is to remove the cakes from the trays and place them one at a time on the press feed belt. When a tray is emptied, it is placed on the overhead belt conveyor and returned to the cutting machines to be refilled.

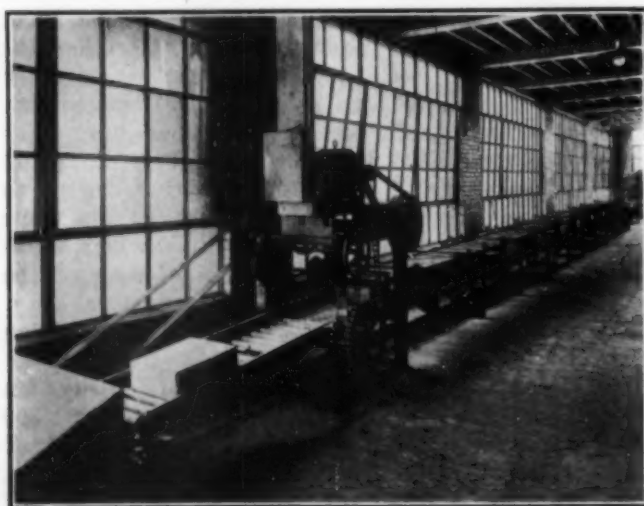
The soap bricks on the press feed belt are automatically fed one by one into the press. This press takes each cake and presses it into the shape desired for the finished cake, at the same time imprinting on the sides of the cake the desired name, trade mark, etc. After this pressing is completed, the cake is automatically discharged to a second belt. This second belt conveys the cake to the wrapping machine. Here the cake is wrapped and passes onto a third belt, which runs down the center of the packing table. On either side of these tables the packers stand and place the cakes of soap in paper cartons as they take them off the belt. The empty cartons are fed in on a gravity roller conveyor which passes over these packing tables, as shown on Fig. 1.

SEALING THE CARTONS

After the cartons are filled they are placed, open side up, on the U-shaped gravity roller conveyor shown in Fig. 1. This conveyor takes the cartons to the point marked "Space for Gluing." Here the flaps of the carton are glued down and the carton is turned over, so that its own weight, pressing it down against the conveyor, tends to seal it. In this way it enters the sealing machine, shown in the accompanying illustration. This machine forces the carton to pass between upper and lower sets of rollers, which exert sufficient pressure to seal it effectually. After passing out of this machine the carton is delivered by gravity conveyor to an inclined conveyor of the push-bar type, which delivers the cartons to the car-loading and storage system of gravity conveyors on the floor below.

LOADING BY CONVEYORS

This system of gravity conveyors, shown on Fig. 2, is so arranged that three cars may be loaded at the same time, the cartons coming either direct from the



SEALING MACHINE AND CONVEYOR TO FIRST FLOOR

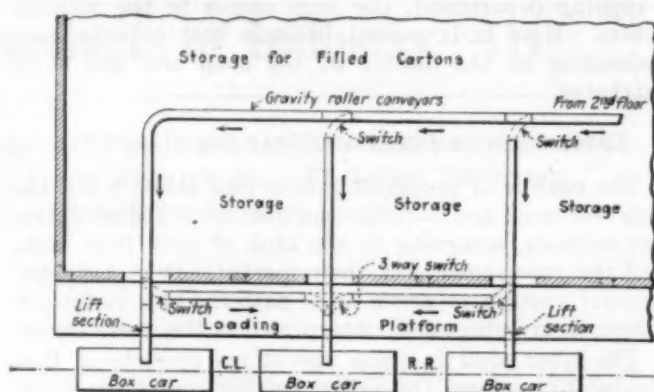


FIG. 2—LOADING CONVEYOR SYSTEM

packing department above or from any one of the storage spaces shown on the figure. This is accomplished by means of an ingenious arrangement of switches. The end sections, which extend into the cars when they are being loaded, can be raised out of the way when not in use so that the track is free for movement of cars. The loading platform, with three cars in position for loading, is shown in the accompanying illustration.

A PLANT FOR MAKING EXPENSIVE SOAPS IN LARGE VARIETY

The second example is a plant for the manufacture of toilet and other similar grades of soap. In the particular plant in question the soap is packed in two ways. That for the general market is pressed into oval cakes bearing the trade name on one side and the manufacturer's name on the other. Each of these cakes is then wrapped in a fancy wrapper. After wrapping, three cakes are placed in a fancy pasteboard box and these boxes are in turn placed in paper cartons or wooden boxes for shipment.

Soaps to be shipped from this plant to South America are cut into bars only. The name and trade mark are pressed into these bars, which are then packed in paper-lined wooden cases of heavy construction, holding 100 bars each. The difference in packing methods is due to the fact that South American shipments undergo particularly rough treatment and precautions must be taken to prevent damage to the soap.

It will be noticed that the soap made in this plant is not put through a drying room between the cutting and pressing. This is because of the manufacturing methods used by the plant, the moisture content of the soap from the frames being right without further drying.

HOW THE SOAP IS HANDLED

Fig. 3 shows the layout of the departments where the finished soap is handled in this plant. The soap which is shipped abroad in the heavy cases is adapted to an extremely simple handling routine. The slabs are brought from the fourth floor to the fifth floor in the elevator shown on Fig. 3 on hand trucks and transferred by hand from these to the cutting machines. The packers stand at the discharge of the cutting machines and as the bars come from the machines, place them in cases which are standing on one of the roller conveyors adjacent. When a case is filled, it is shoved to the end of the conveyor and at this point the cover is fastened on. As fast as the last operation is finished, the boxes are transferred to the gravity conveyor which runs at right angles to those mentioned above. This last conveyor takes the case to the large spiral chute



LOADING PLATFORM AND CONVEYOR

shown on the outside of the building. The cases go down this chute directly into the shipping department.

HANDLING FANCY TOILET SOAPS

The toilet soaps are delivered to the fifth floor in slabs as described above and are transferred from the elevator to the department where they are cut—shown in Fig. 3—on hand trucks. After being cut and pressed into the desired cake form, the cakes are loaded into wheeled transfer boxes and pushed over to the row of twelve packing tables shown.

These soaps are packed, three or more per box, in fancy paper boxes. When the boxes are filled and closed, the packers place them one by one on the gravity conveyors which run between the ends of the packing table and the wall toward the small spiral chute leading to the third floor. These boxes run by gravity down the conveyor to this chute and down the chute to the table marked "Receiving Table" on the third floor.

At this receiving table, the small boxes are placed either in paper cartons or wooden cases depending on where and how they are to be shipped. These cartons and boxes when filled weigh about 200 lb. each. When they are filled and sealed or covered, they run down a gravity roller conveyor which leads from the receiving table to the large outside spiral chute. Then they run down this chute to the shipping department.

THE SHIPPING DEPARTMENT

The foot of the large spiral chute is situated in a one-story building which serves for a shipping department. The outlet of the chute discharges onto a roller conveyor of slight inclination, which serves for distributing the cases and cartons to storage areas or for delivering them to truck or freight car as desired. Due to the slight inclination of this conveyor, the packages move only when slightly pushed. This serves to keep them at rest while they are marked or labeled.

LABOR SAVED IN FIRST PLANT CITED

In the first example given the labor employed from the point where the soap is in the frame up to the point where it is unloaded from the tray to the press is the same as if there were no labor-saving devices employed in the plant. Beyond this point the labor used is as follows: One worker to remove soap bricks from

trays and place them on press feed belts, making three in all. Two workers at each packing table, making six in all. One worker for gluing cartons. Three men on loading platform. Total workers now employed for work in question is thirteen.

Before the labor-saving machinery was installed the labor required was as follows: One worker unloading trays at each press, making three in all. One worker feeding each press, making three in all. One worker feeding each wrapping machine from discharge of press, making three in all. Two workers packing at discharge of each wrapping machine, making six in all. One worker gluing cartons. Six workers trucking sealed cartons from second floor to storage and shipping on first floor. Six workers on first floor loading cars. Total workers formerly employed, twenty-eight.

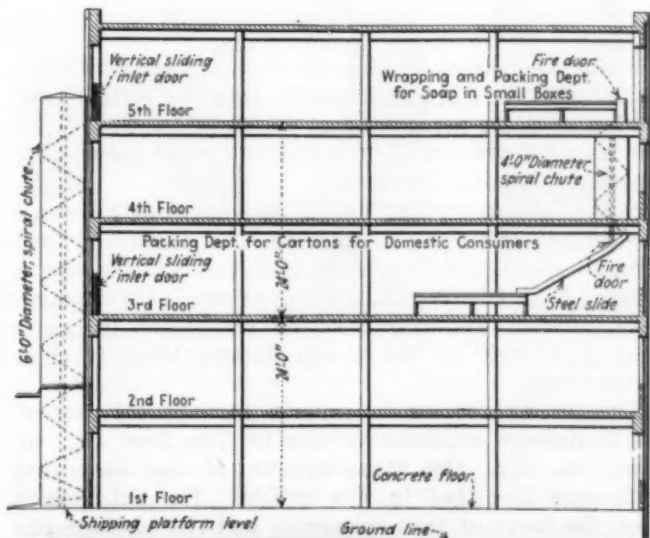
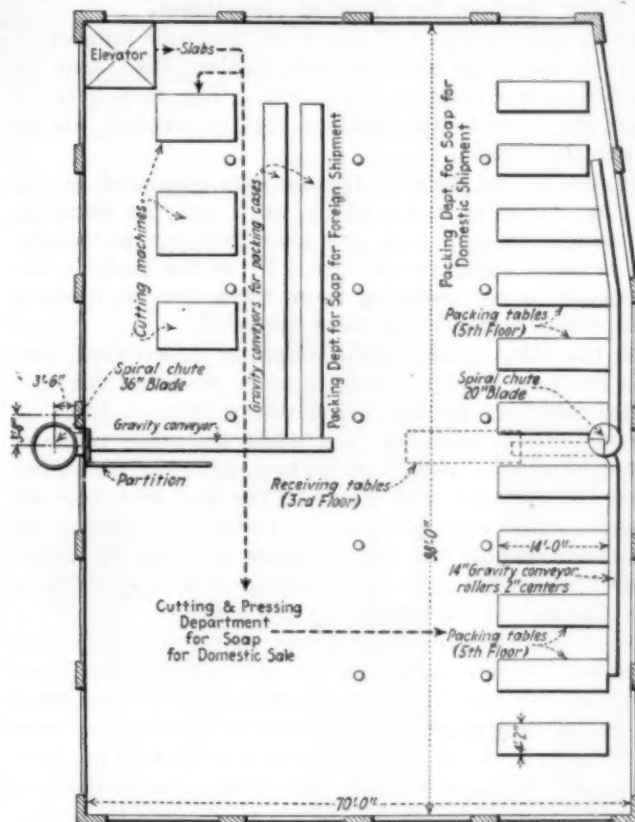


FIG. 3—PACKING DEPARTMENT AND CONVEYORS FOR FINE SOAP FACTORY

The saving, then, in labor due to the installation of labor-saving machinery in this plant was fifteen men, or 54 per cent. Since this type of work requires workers of the same pay-rate throughout, we can safely say that a saving of 54 per cent of this labor cost was effected. As the workers on the press and wrapping machines and at the packing tables were enabled to turn out a larger product than formerly, the actual returns of the new equipment were even greater than this 54 per cent.

LABOR SAVED IN SECOND PLANT CITED

In the second example given the labor must be analyzed in three parts: First, that where the soap is packed for shipment to South America. Second, that where the soap is packed for ordinary shipment. Third, the labor saved in the shipping department.

In the first division of this work the same number of men is used for packing and closing the cases as formerly, this number being five. The men used to truck the cases to the elevator, two in number, are no longer employed.

In the second division the workers employed at the cutting, pressing and packing work and for handling the soap between these processes remains as before, the number being twenty-two. From the packing department to the shipping room there are no workers used, where formerly six were employed.

In the third division, the shipping department, two men are now employed, one to place boxes on the conveyor, the other meanwhile unloading them in truck or car; or one to label and tag, while the other removes boxes from the conveyor. Formerly, for unloading from the elevator with hand trucks and wheeling the boxes to the various required points, six men were needed to handle the same volume of product in the same time. This gives us a saving of four workers in this division of the work.

To recapitulate, the plant now employs twenty-nine workers on this labor where it formerly employed forty-one, so that the saving amounts to 29 per cent. As in the first plant, more volume of product can now be turned out in the same time, so that this 29 per cent does not represent all the advantage made possible through the material handling equipment that was installed.

CONCLUSIONS

From the examples which have been cited above, it is evident that the more complete the handling system used the larger is the percentage of the non-productive labor that can be eliminated, provided all other influencing conditions remain the same.

It is also evident that, taking no account of increased production through elimination of confusion and through speeding up of work, savings made through a lowered labor turnover, and the decrease in the management burden, material handling equipment in many cases pays well by the non-productive labor it eliminates alone.

The writer desires to express his appreciation of the kindnesses extended to him by The Dow Co., of Louisville, Ky., the manufacturer of the conveying equipment described in this article. The data which form the basis of this discussion and the photographs and drawings used for illustrating were made available by The Dow Co., and The Dunning & Lueckel Engineering Co., of New York City.

Commercial Production of Mucic Acid

Mucic acid $[(OH)_2C_6H_4(CO_2H)_2]$ is one of the most recent of the rare organic chemicals to become available on a large commercial scale. It is being produced at Eureka, Mont., by a process patented by Professor Acree of Harvard University and worked out on a plant scale by the International Chemical Products Co., of Baltimore, Md. The process consists in the hydrolysis and oxidation of mixtures of glucose and galactose obtained from the species *Larix occidentalis*, which is commonly known as Western larch. Oxalic and other organic acids are obtained as byproducts.

Some idea of the extent of operations can be obtained from the statement that the Montana plant covers 20 acres and has an annual output of approximately 600 tons of mucic acid. The production has been almost entirely sold to the manufacturers of self-rising flour. The cost of the product is said to be considerably less than that of citric acid or cream of tartar and when its higher neutralizing strength is considered, it is entirely comparable with the cost of high-grade phosphates.

Mucic acid is a white crystalline or powdered material, without water or crystallization. It is readily assimilated in the metabolism of the human body,¹ probably due to the fact that it is a partly oxidized carbohydrate. Most of this company's output is of the chemically pure grade, but a small amount of the technical product has been sold for use in the dyeing of textiles, where it acts as a mordant and fixing agent in the place of cream of tartar. Mucic acid is marketed under the trade name "Cream of Milk Sugar."

The principal use of mucic acid at present is as a baking acid in the self-rising flour industry. It is claimed that its insolubility in the cold enables it to be kept in a baking mixture almost indefinitely without releasing leavening gas. This property is also of value in connection with its use in baking powders. Samples of baking powders containing mucic acid have been kept in incubators saturated with water vapor and at the end of a test of 14 months showed losses of less than 2 to 3 per cent of available carbon dioxide. Theoretically, pure mucic acid will neutralize 80 parts of pure sodium bicarbonate as against 75 parts and 45.6 parts in the case of monocalcium phosphate and cream of tartar respectively. The use as a mordant and chrome assistant in the dyeing of textiles has already been mentioned. It is also believed that the pure acid will be comparative with citric acid in the preparation of effervescent salts, soft drinks, ice cream and other food products.

New Alcohol Mixture for Motor Fuel

Tests recently completed by the Sociedad Nacional de Agricultura of Rio de Janeiro, Brazil, indicate that a satisfactory fuel can be produced at a cost which compares favorably with gasoline. The selling price of alcohol at the Campos sugar mills in Brazil is about 27 cents per gal., while the price of gasoline in Rio de Janeiro is about 75 cents per gal. The alcohol is made from sugar cane residue, at present thrown away because of lack of transportation facilities.

The best results were obtained from a mixture composed of 65 parts alcohol, 25 parts ether, 9.5 parts kerosene and 0.5 part pyridine. The consumption of a heavy Benz car during the test was 98.5 c.c. per kilometer ton of weight, while the consumption of a light 1 American car was 126 c.c. of gasoline per kilometer ton.

¹Biochemisches Handlexikon, vol. 2, 1911.

Corrosion of Petroleum Refining Equipment*

BY R. R. MATTHEWS AND P. A. CROSBY

IN EARLIER PAPERS which have been published in this magazine¹ we have shown that in refining mid-continent petroleum in a so-called pipe still hydrochloric acid is formed as result of the hydrolysis of the magnesium chloride in the brine associated with the petroleum. This caused rapid corrosion wherever the acid vapors condensed, and in consequence increased costs of maintenance. As a preventive measure ammonia was introduced into the vapor system; first the anhydrous was used and later aqua ammonia. This reduced the corrosion and lengthened the life of the apparatus—especially of the condensers. It is true that corrosion may also be caused by dissolved gases, such as hydrogen sulphide, oxygen and carbon dioxide, but hydrochloric acid is only the corrosive agent whose cause and effect have been studied here.

In the present paper further evidence is offered of the corrosion caused by hydrochloric acid produced in refining petroleum, and it is shown that this corrosion is not confined to refineries using the pipe still, but is also noted in installations where shell stills are used.

In this particular case eight stills had been set up for continuous operation—that is, the oil flowed from one still to another, each successive still being held at a higher temperature so that by the time the eighth still was reached the finished residual product could be drawn off. Each still was equipped with a dephlegmator and the necessary condensers and coolers, the latter being of the tubular type. The stills were also equipped so steam could be used in the bottoms of them.

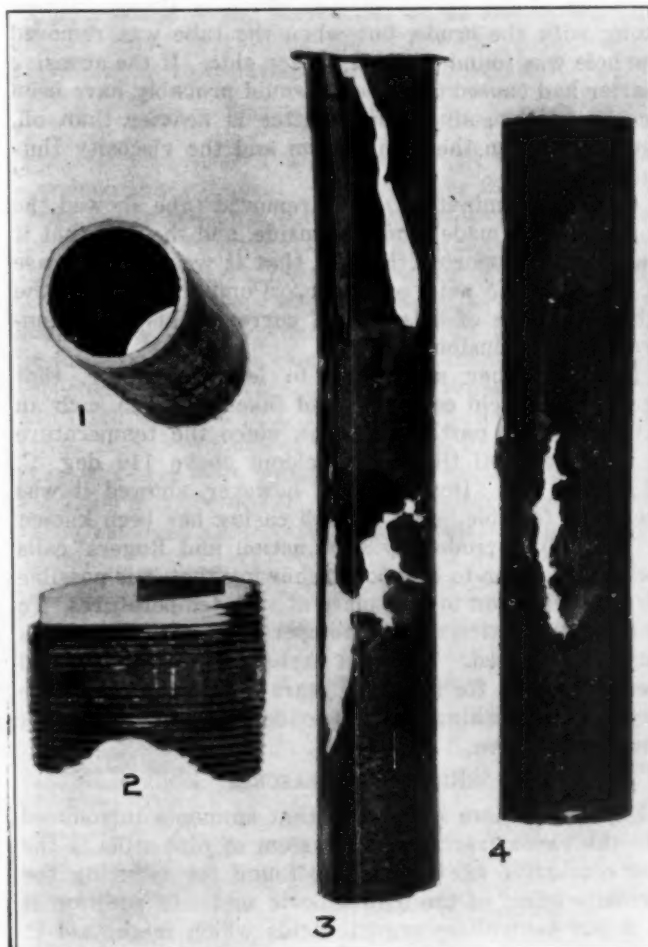
This bench of stills has been operated only periodically since completion with, say, a month's operation and then several months' idleness. After about 2½ years it was noted that some of the tubes in the condenser used with No. 4 still were leaking. The next time the bench was not in operation the leaking tubes were replaced. Examination of the tubes removed showed that the top portion, where the vapor entered, had been corroded for about 18 in. on the oil side until the metal was very thin. This was the same sort of hydrochloric acid corrosion which had previously been observed in the pipe stills, although it had been felt that such trouble might be avoided in the shell stills because considerable salt water would settle from the crude oil in the first still and could be drawn off. Furthermore, the remainder of the brine would be dehydrated in the next still and the salts pass with the oil through the other stills, causing no trouble.

In order to investigate this point in the laboratory, crystalline magnesium chloride was added to water-free oil and then heated up slowly in a distillation flask. Hydrochloric acid vapors began to come over shortly after reaching a temperature of 175 deg. C. (347 deg. F.), and considerably more were noted when the temperature was brought up to 200 deg. C. (392 deg. F.). This showed that the water of crystallization in the crystalline magnesium chloride is sufficient for the hydrolysis. Of course, the brine in the oil consists largely of sodium chloride, and, even though concen-

trated considerably, or reduced to crystalline form in passing through the first stills, there would probably be but little acid liberated at first because of the relatively small proportion of magnesium chloride. As the oil reached the hotter stills, rapid hydrolysis would result. The laboratory results show that when such stills were reached, acid would be produced and carried over with the oil vapors. The result of the latest tests indicates that this hydrolysis takes place most vigorously at temperatures above 150 deg. C. (302 deg. F.); and that sodium and calcium chlorides apparently do not enter into the reaction.

Conditions in No. 4 still were extremely favorable for this hydrolysis of $MgCl_2$. The temperatures of the oil in this still were found to fluctuate between 177 deg. C. (350 deg. F.) to 243 deg. C. (470 deg. F.) during the time the stills had been operated, and this temperature, aided by the fact that superheated steam was being used, undoubtedly resulted in the formation of hydrochloric acid vapors, which were carried over until they struck the cold tubes of the condenser. The condensation there, of course, meant action on the tubes and eventually reduced them to the paper-like thinness which was noted when they were removed.

Later it was also found necessary to change the tubes



FIGS. 1 TO 4—EXAMPLES OF CORRODED PETROLEUM REFINERY EQUIPMENT

Fig. 1—Section of standard No. 13 gage tube used in the tubular condensers and heat exchangers. The piece is set on end so that the thickness of the metal can be noted.

Fig. 2—A short nipple showing how threads on pipes were corroded away.

Fig. 3—A piece of one of the corroded tubes removed from a condenser at the bench of eight stills.

Fig. 4—A portion of the tube taken from the heat exchanger, showing the place where it gave way.

*A paper read before the Petroleum Section of the American Chemical Society at Birmingham, Ala., April 5, 1922.

¹CHEM. & MET. ENG., VOL. 22, No. 11, p. 491 (March 17, 1920), and vol. 23, No. 23, p. 1122 (Dec. 8, 1920).

in the condenser on No. 5 still. Temperatures there were found to have ranged from 182 deg. C. (360 deg. F.) to 260 deg. C. (500 deg. F.). The condensers on the four other stills have not yet caused trouble, so it seems likely that the most of the hydrochloric acid is liberated in the temperature range from 175 deg. C. to 250 deg. C. Michael Freund,² in experiments with Russian petroleum, also found that these temperatures and conditions were most conducive of this type of corrosion.

Other refiners of our acquaintance have also noted this acid formation, but it appears to cause more serious corrosion where steam is used in the stills. No doubt the steam does assist somewhat in the hydrolysis of the magnesium chloride and also dilutes the acid at the point of condensation, thus spreading it over a large surface of the metal.

ACID CORROSION IN HEAT EXCHANGER

Another evidence of acid corrosion was noted when a tube in a tubular heat exchanger, in which the hot residual oil flowed around the tubes and crude oil through them, suddenly started to leak. The heat exchanger was arranged with baffle plates so that the crude oil made four passes through the tubes in going from the bottom to the exit at the top. It was first thought that the tube had given way as a result of the abrasion of the earthy matter which is always carried along with the crude, but when the tube was removed the hole was found to be on the top side. If the abrasive matter had caused the hole, it would probably have been on the bottom, since such matter is heavier than oil, especially when the oil is warm and the viscosity thus decreased.

Careful examination of the removed tube showed the hole had been made from the inside, and the fact that it was on top supported the idea that it was another case of hydrochloric acid corrosion. Comparison with the other examples of this sort of corrosion helped to confirm this conclusion.

It was rather surprising to learn, however, that hydrochloric acid corrosion had taken place to such an extent at that particular point, since the temperature of the crude oil there was seldom above 110 deg. C. (230 deg. F.). Investigation, however, showed it was decidedly feasible, since oil-well casing has been known to be badly corroded by such action and Rogers³ calls special attention to this point, showing that it is possible for this corrosion to take place at such temperatures. To be sure, the action at that temperature is slight, but is not to be ignored. The heat exchanger referred to had been in service for about 1½ years before the tube gave way, thus furnishing concrete evidence that the action is slow but positive.

REMEDIAL MEASURES

Experience here has shown that ammonia introduced into the vapor fractionating system of pipe stills is the best combative agent thus far found for reducing the corrosive effect of the hydrochloric acid. In addition it no doubt neutralizes organic acids which might aid in the corrosion. Ammonia will not prevent such effects as noted in the heat exchanger, however, since it is introduced beyond that point in the vapor system. Also the use of ammonia on a bench of stills would be rather difficult, due to the necessity for introduction into the vapor system of each still. Thus, on the whole, the most practical solution would be to remove the salt

water from the crude oil as it come from the well, or at least before it is put into the pipe line. Various methods of dehydration of crude oil have been proposed and some are in use, but none has yet removed the brine so thoroughly that this sort of corrosion would be entirely prevented.

The authors desire to acknowledge the assistance of P. E. Foster and R. C. Roberts, who are directly in charge of the stills where these observations have been made.

Roxana Petroleum Corporation,
Wood River, Ill.

The A.P.I. Scale for Reporting Gravity of Liquid Petroleum Products

In reporting the gravity of liquid petroleum products, the United States Petroleum Association in 1864 adopted a scale, or rather a set of instruments graduated in accordance with a scale, on which the readings were expressed in "degrees Baumé." Since that time this scale has been in general use, without change, throughout the petroleum industry. Later investigation following the adoption of this scale showed it to be represented by the conversion modulus 141.5.

In industries other than the petroleum industry, however, an American standard Baumé scale based on a modulus of 140 has found universal use for reporting the gravity of liquids lighter than water.

The confusion arising from the use of the two scales—namely, 140 and 141.5—the readings on both of which were designated in "degrees Baumé," was brought to the attention of the American Petroleum Institute by representatives of the petroleum industry and, at the same time, the necessity was urged of having one or the other of the two scales formally adopted as a single standard for the industry. The technical advisory committee of the American Petroleum Institute then recommended the adoption of the gravity standard based on the modulus of 141.5, which is most generally in use by the petroleum industry, and on Jan. 23, 1922, the Institute transmitted broadcast to the oil industry a questionnaire which was, in substance, as follows: (1) Do you approve of the modulus 141.5 as applied to the oil industry? (2) Do you approve that the scale be known as the "American Petroleum Institute Scale"? To this inquiry the replies were almost unanimously in the affirmative.

After careful consideration of the question it has now been agreed by the American Petroleum Institute, the Bureau of Mines and the Bureau of Standards that the scale based on the modulus 141.5 be approved and recommended for exclusive use in the petroleum oil industry, and that this scale be designated the "American Petroleum Institute Scale." This action is believed to be in the interest of uniformity of practice within the petroleum industry.

When reporting gravities of liquid petroleum products it is to be understood, therefore, that the hydrometer scale based on modulus 141.5 is standard, and the expression "degrees A.P.I." should be used in order to avoid confusion with the scale based on modulus 140. In reporting the gravity of liquids lighter than water, the United States Bureau of Standards has requested that the expression "degrees Baumé" apply only to the scale based on modulus 140. In cases of doubt or when disputes may arise it is recommended that the gravity reported in "degrees A.P.I." be followed by the statement of the "true specific gravity" in parentheses.

³Chem. Zeit., vol. 43, No. 149, p. 587.

²Professional Paper 117, U. S. Geological Survey, p. 80.

Dip-Brazing With 80:20 Brass and the Heat-Treatment of Brazed Joints

Determination of Satisfactory Methods for Dip-Brazing—Tests on the Strengths of Joints and the Effect of Heat-Treatment—Metallography of Brazed Joints—An Explanation of the Great Strength of the Bond Between Brass and Steel

BY E. V. SCHAAL

Metallurgist, U. S. Air Service, Engineering Division, McCook Field, Dayton, Ohio

BRAZING is by no means a new art, but there are many phases of the subject that have not been covered by the available literature.¹ Especially does this apply to dip-brazing in a high melting point brass and subsequent heat-treatment of the parts. Airplane construction has opened a new field for this art, and in order to use alloy steels at their fullest advantage, heat-treatment of fittings after brazing has become desirable if not necessary.

The experimental work with which this paper is concerned was carried out in the metallurgical laboratory of the Engineering Division of the U. S. Air Service at McCook Field with a view toward establishing a method of satisfactorily dip-brazing and heat-treating alloy steel fittings as well as obtaining data on the strength of brazed joints both in the heat-treated and non-heat-treated conditions.

BRAZING BATH

The brazing was done in an ordinary plumbago crucible heated in a melting furnace fired with gas. The brass was made by first melting the copper under a layer of borax or boric acid and finally adding preheated zinc in small pieces. Using a flux over the molten metal held down the zinc loss due to volatilization. The proportion of 80 per cent copper and 20 per cent zinc was used on all the brazed joints reported herein (except a few specimens when a nickel brass was used), varying less than 1 per cent, as shown by chemical analyses made after the brass had been used.

SURFACE APPEARANCE CAUSED BY VARIOUS FLUXES

It was found that a clean specimen could not be obtained by the ordinary method of dipping in brass covered with a layer of borax, due to the rapid volatilization of the zinc and oxidation of both zinc and copper on the surface of the specimen after it was removed. This difficulty is not encountered in brazing with alloys of lower melting point. The high brazing temperature required for 80:20 brass apparently renders the flux very fluid, and permits it to run off the specimen almost the instant it is withdrawn, thus exposing the surface of the hot metal to the atmosphere. In an effort to overcome this difficulty, boric acid and potassium metaborate were both tried as fluxes. A slight improvement was found with potassium metaborate, but it was discovered that a thick layer of boric acid (1 in. or more) nearly obviated the difficulty. However, there were still discolored spots on the specimens.

It was also discovered that if the specimen were immediately transferred into a bath of molten borax or boric acid at about 1,500 deg. F., and held there from 30 seconds to 1 minute, the surface luster was preserved after it had been withdrawn and cooled to room temperature. When a cooling bath of flux is used, its temperature should be 200 to 300 deg. F. below that of the brass. Borax can be kept at a lower temperature, but boric acid becomes too viscous below 1,600 deg. F. and clings in a mass to the specimens when they are withdrawn. Boric acid is otherwise much more desirable, because it can be washed off in hot water, while borax must be cracked off either by quenching, by pounding with a hammer or by a sand blast.

JOINTS MADE BY DIFFERENT FLUXES

As it was desired to determine the flux that would produce the strongest joint with the 80:20 brass, five butt specimens of S.A.E. 1020 steel were brazed with each of the following fluxes: Potassium metaborate, boric acid, borax. Borax was used as a cooling flux.

All the specimens were preheated to a dull red heat before dipping in order to speed up the process and prevent cooling the brass unduly after inserting each specimen. They were allowed to remain in the brass at 1,825 to 1,850 deg. F. for 2 minutes, during which time they were moved up and down. Thereupon the brazed pieces were transferred to a cooling flux of borax at 1,500 to 1,550 deg. F., where they remained 1 minute, then removed and cooled in air. Results are shown in Table I.

TABLE I—DATA ON PRELIMINARY TENSILE TESTS OF BUTT JOINTS TO DETERMINE BEST FLUX

Flux Used	Ult. Str. Lb./Sq. In.	Average	Remarks
Metaborate, $K_2B_4O_7$	28,970	.....	Joint only partly filled
Metaborate, $K_2B_4O_7$	30,800	.....	.....
Metaborate, $K_2B_4O_7$	33,550	.....	.....
Metaborate, $K_2B_4O_7$	34,350	31,920	Load undetermined
Boric acid, H_3BO_3	25,560	.....	Joint filled
Boric acid, H_3BO_3	34,730	.....	Joint filled
Boric acid, H_3BO_3	31,130	.....	Joint filled
Boric acid, H_3BO_3	32,040	.....	Joint filled
Boric acid, H_3BO_3	28,550	30,400	Joint filled
Boric acid, H_3BO_3	34,850	.....	Joint filled
Borax, $Na_2B_4O_7$	36,950	.....	Joint completely filled
Borax, $Na_2B_4O_7$	31,710	.....	Joint filled
Borax, $Na_2B_4O_7$	39,760	.....	Joint filled
Borax, $Na_2B_4O_7$	40,900	36,830	Joint completely filled

Borax appears to be the most desirable flux from the standpoint of the strength of the joint. However, the latter part of the work reported herein was done with a layer of boric acid 1 or 2 in. thick as a flux, and the cooling flux was dispensed with. As noted above, this was done to simplify the process, and it was found that the specimens came out as clean by this method as

¹"The Metallography and Heat-Treatment of Metals Used in Aeroplane Construction," F. Grotts, CHEM. & MET. ENG., Aug. 1 to Oct. 1, 1918. "Brazing, Welding and Soldering in Aeroplane Construction," Boulton, Aerial Age, Oct. 6, 1919. "The Heat-Treating of Brazed Fittings for Aircraft," Archibald Black, Journal, S.A.E., March, 1920.

when a cooling flux was used and borax used on the brass. It is believed, however, that borax is more active as a flux than boric acid, and therefore it removes oxide from the joint much quicker, insuring a better joint where there happens to be an excessive amount of scale caused from preheating in an oxidizing atmosphere.

As a means of preventing oxidation of the joints of airplane fittings during preheating, a paste was made by mixing equal parts of borax and boric acid in a little water. The parts to be brazed were dipped into this mixture before heating, and it was found that preheating to a dull red heat produced no scale, as the surfaces and joints were protected by a film of the molten flux. It may be suggested also that the use of a flux while preheating would tend to increase the reliability of the brazing job, since it not only prevents scaling of the joints during preheating but also insures that the joint is well supplied with flux before the brass comes into contact with it.

PREPARATION OF BUTT SPECIMENS

Standard tensile test specimens were cut in the middle and the ends faced off square in a lathe. These specimens were left approximately 0.08 in. oversize and no threads were cut on the ends. In order to hold the two parts of each butt specimen in place while brazing, two steel strips, or stays, were welded to opposite sides by means of an acetylene torch, care being taken to align the two parts as nearly as possible. During welding the heat was confined as much as possible to the ends, and there it was very much localized. The middle part, where the braze was to be made, never became hotter than 1,000 or 1,100 deg. F. during the welding of the stays, and excessive oxidation of the surfaces to be brazed was therefore avoided.

Final machining consisted of cutting off the stays, turning the specimen true in a lathe and cutting threads on both ends. This left them clean and true with no brass on them except at the joint.

STRENGTH OF BUTT JOINTS

After it was determined to use borax as a flux over the brass, two series of tensile tests on butt joints were made, as shown in Tables II and III. In both

TABLE II—TENSILE TESTS OF CARBON STEEL BUTT JOINTS, NOT HEAT-TREATED

Ult. Str., Lb./Sq. In.	Remarks	Ult. Str., Lb./Sq. In.	Remarks
33,480	Joint $\frac{1}{2}$ filled	35,990	Joint 15/16 filled
37,710	Joint $\frac{1}{2}$ filled	39,300	Joint $\frac{1}{2}$ filled
34,180	Joint $\frac{1}{2}$ filled	28,670	Joint $\frac{1}{2}$ filled
37,090	Joint $\frac{1}{2}$ filled	37,090	Joint $\frac{1}{2}$ filled
14,640	Joint $\frac{1}{2}$ filled	38,790	Joint 15/16 filled
23,910	Joint $\frac{1}{2}$ filled		
		Av. 32,680	

cases the brazing temperature was kept within 25 deg. of 1,850 deg. F., the specimens were immersed 2 minutes, then transferred for 1 minute to a borax bath at $1,525 \pm 25$ deg. F. Carbon steel samples were machined and tested, giving an average strength at the joint of 32,680 lb. per sq.in. with three bad samples below this figure. S.A.E. 2335 nickel steel specimens in Table II were quenched in oil from 1,500 deg. F., and drawn at 1,000 deg. F. before testing. Under these circumstances the average strength at the joint was 62,290 lb. per sq.in. and of the steel 149,000 lb. per sq.in. Four samples were so imperfectly joined as to give strengths below this average.

The effect of heat-treatment upon brazed joints is yet uncertain. After obtaining the increased strength from heat-treating nickel steel butt joints as compared with the non-heat-treated carbon steel joints, it was thought that perhaps heat-treatment was a means of increasing the strength of the bond between the two pieces of steel, but later results do not uphold that idea. It is more likely that the brass in tension in the butt joints was supported more by the hard nickel

TABLE III—TENSILE TESTS OF NICKEL STEEL BUTT JOINTS QUENCHED IN OIL FROM 1,500 DEG. F. DRAWN IN AIR AT 1,000 DEG. F.

Ult. Str., Lb./Sq. In.	Remarks	Ult. Str., Lb./Sq. In.	Remarks
45,500	Joint $\frac{1}{2}$ filled	63,970	Joint 15/16 filled
48,460	Joint $\frac{1}{2}$ filled	72,730	Joint 15/16 filled
71,590	Joint 15/16 filled	67,690	Joint 15/16 filled
69,640	Joint 15/16 filled	35,450	Joint $\frac{1}{2}$ filled
86,580	Joint completely filled		
61,270	Joint $\frac{1}{2}$ filled	Av. 62,290	

steel than by the soft carbon steel so that the process of necking (which originates in the brass itself) was retarded, causing a higher breaking load. Such a phenomenon as that just described could not take place in a shear test and there was later found no evidence of an increase in shearing strength due to heat-treatment or to the use of nickel steel.

STRENGTH OF THE BRASS

After completing the brazing of the butt joints, three tensile specimens were cast from the brass in sand molds. These specimens were used for tensile tests, shear tests and chemical analysis, and gave extremely consistent results. The castings for the test specimens were poured at the brazing temperature (1,825 to 1,850 deg. F.). Results follow:

Chemical analysis: Cu 79.12, Zn 19.54, Fe 1.34, Sn trace, Pb trace. Ultimate strength in tension, 44,803 lb. per sq.in. Elongation in 2 in., 28.7 per cent. Ultimate strength in shear, 33,530 lb. per sq.in.

TENSILE TESTS ON LAP JOINTS

A series of carefully made lap joints were tested in tension, but the results were so variable that this method was abandoned as fundamentally incorrect. Therefore a shear specimen was designed and used on all later work on brazing. Butt specimens, while giving fairly uniform results, were extremely difficult

to manipulate and expensive and so were discarded in later tests. Shear specimens were made of $\frac{1}{4}$ -in. stock, lapped about $\frac{3}{8}$ in. and riveted at each end, making a piece approximately $1\frac{1}{2}$ in. in length with a distance between the rivets slightly exceeding 1 in. One of these specimens

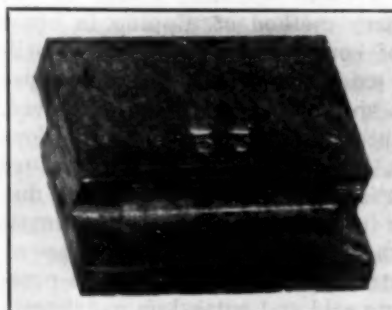


FIG. 1—SHEAR SPECIMEN AFTER BRAZING AND BEFORE MACHINING

is shown in the photograph, Fig. 1, taken after the specimen had been brazed. A hole was drilled in one corner through which a wire could be inserted for dipping. After the brazing had been completed, both ends of the specimen were cut off, thus removing the rivets, and the area of the lap was reduced to exactly $\frac{1}{2}$ sq.in.

NICKEL BRASS FOR BRAZING

After adopting the shear specimen for brazing tests, the investigation was divided into four steps, as follows:

1. Determination of the merits of a nickel brass.
2. Determination of the proper brazing temperature.
3. Determination of proper clearance between parts.
4. Determination of the effect of heat-treatment.

The first inquiry was conducted by brazing ten specimens of low-carbon steel with 80:20 brass and ten with a nickel brass made with about 6 per cent of nickel substituted for that amount of copper. A clearance of about 0.0025 in. was used on these specimens, a thin copper shim being placed at each end between the two parts just before riveting. A brazing temperature of 1,850 to 1,860 deg. F. was maintained. Borax was used as a flux and boric acid used as a cooling bath. Results follow:

Ultimate strength in shear of the 80:20 brass joints: 36,840, 36,800, 37,680, 34,800, 31,320, 35,840, 36,300. Average: 35,650 lb. per sq.in. Three specimens were not completely brazed over the joint, giving values of 29,890, 25,480 and 28,760. If these are computed with the others, the average strength is lowered to 33,370 lb. per sq.in., approximately the shearing strength of the brass itself.

None of the specimens joined with the nickel brass was completely brazed. Ultimate strength in shear: 25,340, 26,480, 21,540, 25,060, 21,200, 22,060, 24,420, 27,140, 26,860, 24,440. Average: 24,450 lb. per sq.in.

Specimens of the nickel brass were cast and tested with the following results:

Chemical analysis: Cu 73.3, Ni 5.4, Fe 0.85, Zn 20.4. Tensile strength, lb. per sq.in. (average of three $\frac{1}{2}$ -in. specimens), 34,666. Elongation in 2 in., per cent, 34. Shear on one $\frac{1}{2}$ -in. specimen, lb. per sq.in., 20,450.

Therefore, the use of nickel in the brazing brass with a view toward improving the flowing qualities proved to be useless, as it not only weakened the brass but gave a less uniformly filled joint.

CORRECT TEMPERATURE FOR BRAZING

Before the work was started on the shear specimens, no systematic determination of the proper brazing temperature was made, but the general appearance and behavior of the brass during the brazing of the butt and lap joints had led to the conclusion that 1,850 deg. F. was the proper temperature to use with 80:20 brass. This conclusion was found to be correct after the second series of the shear specimens, shown in Table IV, had

TABLE IV—SHEAR TESTS TO DETERMINE EFFECT OF BRAZING TEMPERATURE

Brazing Temp., Deg. F.	Ult. Str., Lb./Sq.In.	Average Ult. Str., Lb./Sq.In.	Brazing Temp., Deg. F.	Ult. Str., Lb./Sq.In.	Average Ult. Str., Lb./Sq.In.
1,830	38,400	.....	1,870	38,000	.....
1,830	39,000	.....	1,870	36,660	.....
1,830	40,200	39,200	1,870	38,520	37,730
1,850	28,880*	.....	1,890	34,800	.....
1,850	36,800	.....	1,890	36,880	.....
1,850	36,960	34,180	1,890	29,600*	33,760

* Flaw in brazing.

been tested.² If the imperfect specimens be disregarded, it will be observed that there is a variation of approximately 4,000 lb. per sq.in. in the averages from each group and that the greatest strength is obtained with the lowest brazing temperature. While these results

²All specimens were low-carbon steel, brazed with 80:20 brass under borax, and cooled in boric acid.

indicate that the low temperature of 1,830 deg. is best, there is danger in maintaining the brass at that temperature, because it is liable to freeze around the specimens when they are inserted. Raising the temperature to 1,850 deg. prevents this danger and does not lower the strength of the joint any appreciable amount. This latter temperature has been used for brazing airplane fittings, and has proved very satisfactory.

EFFECT OF CLEARANCE BETWEEN PARTS

After the second series was completed the brazing temperature of 1,850 deg. F. was adopted as the proper one and the third group of soft steel specimens was made up, varying the clearance from zero to 0.0075 in. There were twenty specimens in this group with four different clearances. Table V shows the results.

TABLE V—SHEAR TESTS TO DETERMINE THE EFFECT OF CLEARANCE

No. of 0.0025-In. Shims in Joint	Ultimate Strength, Lb./Sq.In.	Average Ult. Str., Lb./Sq.In.	Per Cent of Surface Brazed
None	30,510	.....	85
None	36,470	.....	95
None	30,370	.....	92
None	36,360	.....	98
None	32,430	33,230	95
1	29,720	.....	94
1	29,560	.....	90
1	27,740	.....	60
1	28,230	.....	90
1	34,630	29,980	95
2	28,820	.....	80
2	22,240	.....	55
2	31,130	.....	96
2	27,610	.....	75
2	31,560	28,270	98
3	25,560	.....	75
3	31,560	.....	90
3	28,810	.....	85
3	28,920	.....	90
3	30,320	29,030	90

It is evident that a very small clearance is best. Of course it is possible on a closely fitted joint, put together with a great deal of pressure, to prevent penetration of the brass, but in general a thin crack fills better than a thick one. An explanation of this probably lies in the fact that the brass enters the crack by capillary attraction, and the smaller the capillary the greater the attraction becomes.

HEAT-TREATMENT OF SHEAR JOINTS

Twenty-one carbon steel specimens and the same number of S.A.E. 2330 nickel steel specimens were prepared. Following the best results obtained in the previous work, no clearance was used, and the brazing temperature was maintained at 1,850 deg. F. as nearly as possible. Borax flux and a boric acid cooling bath were used. Heat-treatment consisted of a quench in oil from 1,625 deg. F. for the carbon steel and 1,500 deg. F. for the nickel steel, followed by a draw to 1,000 deg. F. in saltpeter for all specimens. Half of the specimens made from each steel were heat-treated and the remainder were tested without heat-treatment. The machine work was all completed on these specimens before heat-treatment. Results are shown in Table VI.

The results from the heat-treated specimens were so poor that it was decided to braze some 6-in. specimens that had been spot-welded with the acetylene torch to hold them together. They were made of carbon steel, six of $\frac{1}{2}$ -in. strips and six of $\frac{1}{4}$ -in. strips. These were heat-treated (quenched from 1,600 deg. F. and drawn to 1,000 deg. F.) after brazing and then tested with a chisel and hammer to determine whether the

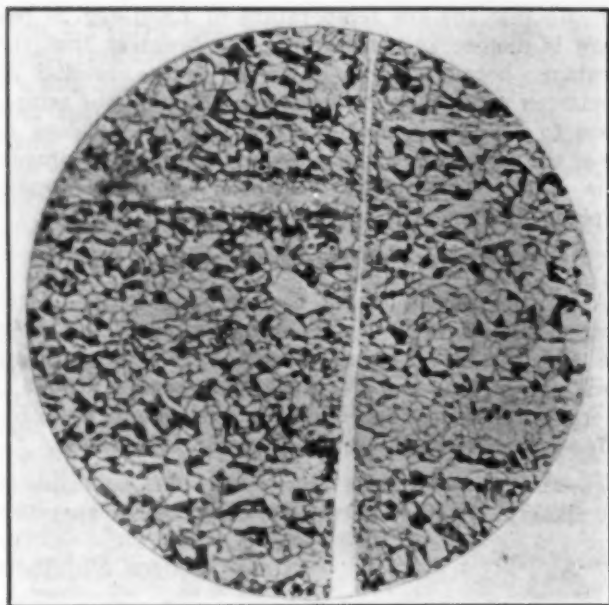


FIG. 2—BUTT JOINT IN LOW-CARBON STEEL, WITH BRASS ENTERING A MICROSCOPIC CRACK. $\times 100$

joint had been injured by the treatment. They were found to be in good condition and three shear specimens were cut from two of the specimens made of $\frac{1}{2}$ -in. stock. Ultimate strength of these specimens was 27,520, 31,820 and 23,660 lb. per sq.in. respectively. The latter showed incomplete brazing, but the two others held until the steel bent—testing was done with one end of shear knife unsupported. Evidently these larger, more rigid specimens were not so badly damaged by the heat-treatment.

TABLE VI—SHEAR TESTS TO DETERMINE EFFECT OF HEAT-TREATMENT

Low-Carbon Steel		Nickel Steel	
Not Heat-Treated	Heat-Treated	Not Heat-Treated	Heat-Treated
Ultimate Strength	Ultimate Strength	Ultimate Strength	Ultimate Strength
Lb./Sq.In.	Lb./Sq.In.	Lb./Sq.In.	Lb./Sq.In.
29,000	2,080	27,480	12,440
31,360	36,490	29,740	20,400
9,640		32,650	8,590
29,440	20,060	26,390	5,820
26,700	26,130	32,060	7,280
26,640	27,080	34,610	8,650
29,940	11,620	29,670	17,750
33,060	640	38,270	7,040
28,160	360	32,160	9,590
27,120	28,530	20,200	9,540
Av. 29,100	16,990	30,320	10,710

TABLE VII—SHEAR TESTS ON BRAZED CARBON AND NICKEL-STEEL

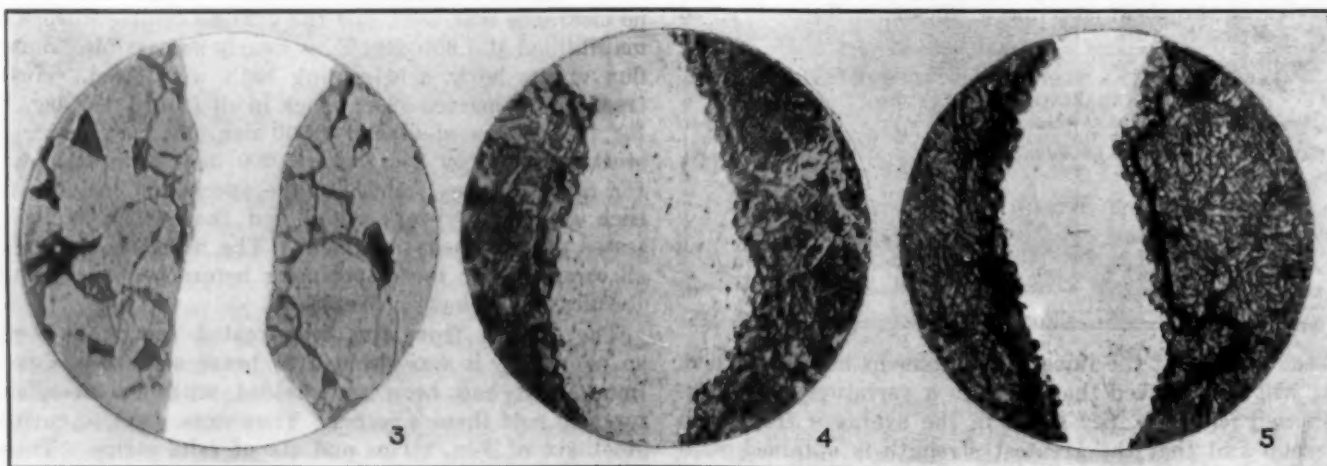
Low-Carbon Steel		Nickel-Steel	
Ultimate Strength	Character Of Fracture	Ultimate Strength	Character Of Fracture
Lb./Sq.In.		Lb./Sq.In.	
495	Oxide	5,630	Oxide $\frac{1}{2}$ brazed
23,010	$\frac{1}{2}$ brazed	30,280	$\frac{1}{2}$ brazed
18,240	$\frac{1}{2}$ brazed	36,550	$\frac{1}{2}$ brazed
19,900	$\frac{1}{2}$ brazed	1,370	$\frac{1}{2}$ brazed
660	Oxide	22,420	brazed
		25,000	brazed

Thereupon another set of six each of nickel-steel and carbon-steel shear specimens was made, brazed and heat-treated. The final machining of this set of specimens was left until after the heat-treatment in order that the joints might be supported by the rivets during that operation. No shims were used in the joint. Brazing was done at 1,850 deg. F. under a deep flux of boric acid, and no cooling bath was used. Carbon steel was quenched from 1,600 deg. F., nickel steel from 1,500 deg. F. in oil, and all drawn back to 1,000 deg. F. after brazing but before machining. The results of this test are shown in Table VII.

Failure at low strength of nearly all of the heat-treated shear specimens cannot be satisfactorily accounted for, inasmuch as specimens of the same dimensions cut from the 6-in. spot-welded specimens gave good results. That the heat-treatment of first specimens weakened the bond cannot be doubted; since these were taken at random from the whole series, all brazed at the same time and under the same conditions, producing unheat-treated specimens which were uniformly good. Even heat-treating these last shear specimens with the rivets in both ends of each seemed to have somewhat of the same effect as it did on those that were machined before heat-treatment. But on none of the other types of specimens was there any detrimental effect from heat-treatment. It must be concluded, therefore, that the particular type of specimen that was used for shear tests was especially susceptible to deterioration. Just how extensive this may prove to be in airplane fittings cannot at present be stated, but no such trouble has thus far been experienced on brazed and heat-treated fittings made of nickel steel.

METALLOGRAPHY

Figs. 2 to 9, inclusive, are microphotographs taken of several representative brazed joints, all etched with 5 per cent HNO₃ in alcohol. Fig. 2 shows how the brass flows into a microscopic crack and it also demonstrates

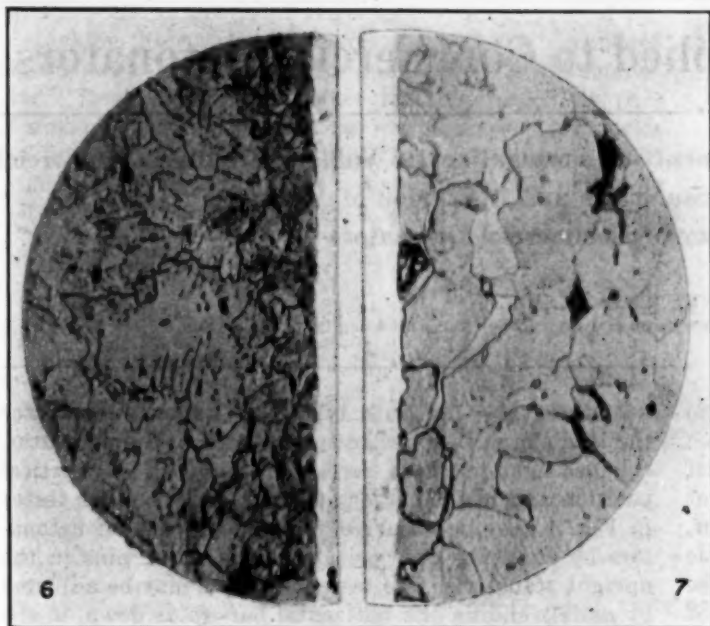


FIGS. 3 TO 5—SPECIAL INTERGRANULAR CONSTITUENT. $\times 350$

Fig. 3—Low-carbon steel, no heat-treatment.

Fig. 4—Nickel-steel, no heat-treatment.

Fig. 5—Nickel-steel after heat-treatment.



FIGS. 6 AND 7—LAP JOINT IN CARBON STEEL, RESPECTIVELY BEFORE AND AFTER HEAT-TREATMENT. $\times 500$

that this low-carbon steel does not develop large grains when brazed at 1,850 deg. F. Fig. 3 shows the same joint at a higher magnification, and reveals a constituent at the boundaries of the ferrite grains which has formed out of the brass in association with the iron. This constituent does not reveal itself to the eye on the un-etched surface of the specimen, but after a light etch of nitric acid in alcohol it is clearly differentiated from the brass and the normal constituents of the steel.

Fig. 4 shows a similar constituent in a nickel-steel specimen. Here it presents a brownish tint when etched with HNO_3 , instead of the gray color of Fig. 3, suggesting that the nickel in solid solution with the ferrite has also entered the substance which encroached upon the ferrite grain boundaries. In Fig. 5, heat-treated after brazing, this constituent shows a darker shade of brown, but with indistinct boundaries as in Fig. 4. All the remaining microphotographs show this constituent either in the light gray color or in the fuzzy brown. Note Fig. 7, in which it shows light colored with distinct boundaries, and Fig. 6, in which it is brown and fuzzy after heat-treatment. Note also that in all carbon steels, heat-treatment is necessary to cause diffusion of this constituent, while in the nickel steel the diffusion takes place before heat-treatment, and that the diffusion is accompanied by a change in color from gray to brown. As mentioned above, a very light etch is necessary to bring out any difference in color between the special constituent and the steel. There is apparently no tendency for the steel to diffuse into the brass, which is reasonable, since the steel remains solid, while the brass is molten.

The fact that all well-brazed joints which fail while being tested or otherwise do so by severing the brass and not by separating the brass from the steel is readily explained by the interlocking of the two by means of

an intermediate constituent, which is undoubtedly stronger than the brass.

SUMMARY AND CONCLUSIONS

Preheating to a dull red just before brazing is found desirable, but a higher temperature or continued heating should be avoided on account of oxidation of the surfaces to be brazed. It is found advisable to coat the parts to be brazed with a paste made of borax and boric acid to prevent oxidation during preheating.

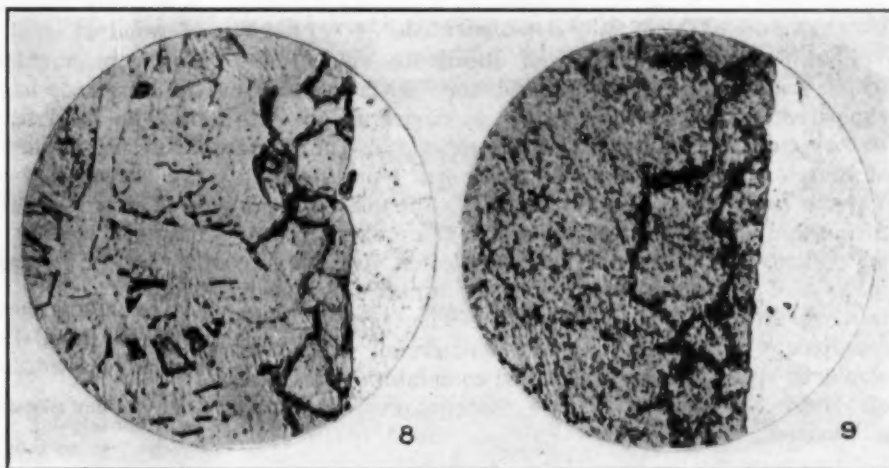
Borax gives the best joints when brazing with 80:20 brass, but should be used in connection with a cooling flux, preferably boric acid, in order to prevent surface oxidation of the specimen.

The proper brazing temperature is found to be 1,850 deg. F.

The best joints are obtained when the surfaces to be brazed are fastened close to each other by any suitable means without the use of shims or spacers.

The strength in pure tension of joints made with carbon steel, untreated, is approximately equal to the strength of the brass in tension. That of the nickel steel joints, heat-treated, is nearly twice the strength of the brass. The strength of joints in pure shear is approximately equal to the shearing strength of the brass. The shearing strength is also approximately equal to the tensile strength of the brass.

Nickel steel joints tested in shear give approximately the same results as carbon steel joints tested in shear.



FIGS. 8 AND 9—LAP JOINT IN NICKEL STEEL, RESPECTIVELY BEFORE AND AFTER HEAT-TREATMENT. $\times 350$

Heat-treatment of brazed parts is shown to deteriorate certain types of joints brazed with 80:20 brass.

Metallographic study of brazed joints shows that low-carbon steel is not overheated by dip-brazing, and reveals an intermediate constituent between the brass and the steel which serves to hold the brass and steel together in the joint.

Aluminum Production in 1921

The value of the aluminum produced in the United States in 1921 was \$10,906,000, as compared with \$41,375,000 in 1920. This great decrease was due not only to a decrease in the price of the metal but to the large curtailment of its use in the automotive industries. Imported aluminum could be bought throughout the year at 2 to 3 cents below domestic prices.

The Lead Plate Test as Applied to Commercial Detonators

A Description of the Test and Series of Experiments Demonstrating Its Value in Grading Commercial Detonators According to Well-Defined Standards and Discussion of Various Factors Influencing the Efficiency of Commercial Detonators

BY BENNETT GROTTA

Detonator Section, Reynolds Experimental Laboratory, Atlas Powder Co.

IN THE entire realm of commercial explosives, no more important rôle can be found than that played by the seemingly insignificant detonator. The best explosive on the market will not function properly, if at all, with an improperly designed or defective detonator, while, on the other hand, comparatively low-grade explosives, ordinarily incapable of application, may be rendered most useful by employing specially constructed detonators. In short, the detonator is the brain and nerve system at whose command the brawn of high explosives is converted into useful work. It is doubtful if Nobel's invention of dynamite in 1864 would have been a memorable contribution to the development of commercial explosives had he not also, 3 years later, suggested the use of fulminating mercury detonators. Since that time numerous other explosive compounds have been proposed for a similar purpose, but as yet the advisability of wholly dispensing with fulminate of mercury has not been fully demonstrated.

That particular property of fulminate of mercury which renders it so well suited for initiating high explosives is difficult to describe; to devise an absolute test or means of measuring this property in fulminate of mercury or other compounds is still more difficult. Yet the need for such a test which is capable of application and interpretation, by either the maker or user of explosives, is urgent. The user could avoid many costly and dangerous misfires if he would only ascertain whether his detonators were efficient and in good condition. Manufacturers of commercial explosives would be spared many unjustified complaints if the use of inefficient and defective detonators could be eliminated.

Numerous tests have been proposed during the history of commercial detonators, but of these there is one which has survived the trial of more than a quarter of a century of extensive application and which is today the most widely known and universally used of all. It is known as the lead plate test and consists of firing a detonator while supported in a vertical position, its base resting on the center of a lead plate about $1\frac{1}{2}$ in. square by $\frac{3}{8}$ in. thick. The purpose of this article is to describe the application of the lead plate test, the interpretation of results in terms of ability to initiate commercial explosives, and also to describe some of the factors which affect the efficiency of detonators as revealed by this test.

DEVICE USED FOR TEST

A very satisfactory lead plate testing apparatus is shown in Fig. 1. As many as seventy tests per hour have been made with this machine. Another modification is shown in Fig. 2. It should be observed that the

essential feature of both types is a hollow support for the lead plate and a device for supporting the detonator, crimped onto a short section of fuse in a vertical position and in the center of the lead plate. The tester in Fig. 1 may be adjusted for various sizes of detonators by changing the position of the cotter pins in the upright standards. The tester in Fig. 2 may be adjusted by merely sliding the horizontal bar up or down on the two vertical standards. A complete tester could be made by any blacksmith in an hour's time and would be ready for immediate use in any well-barricaded location.

Lead plates may be cut from 12-lb. sheet lead, but it is more convenient and economical to buy the plates ready cut.¹ Tape fuse may be purchased in 2-in. lengths, which are convenient when a large number of tests are to be made.² Ordinary safety fuse, however, is entirely satisfactory. The barricade should be either of wood at least 2 in. in thickness or of sheet iron at least $\frac{1}{2}$ in. in thickness. Lighter lumber may be used if the barricade is steel lined. Obviously, the same tester may be used for testing electric detonators, the only difference being that the lead wires, instead of the fuse, are threaded through the guide, and the detonator is fired from a safe distance by means of an electric battery.

INTERPRETATION OF PLATE TESTS

The appearance of the lead plate after the detonator is fired furnishes a pictorial representation of the explosive action of the detonator charge. In the center

¹Ready cut lead plates may be obtained from the United Lead Co., Philadelphia.

²Two-inch lengths of fuse may be obtained from the Ensign Bleckford Co.

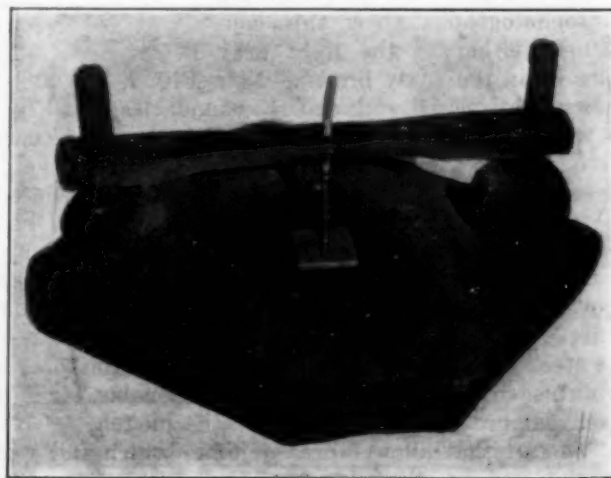


FIG. 1—DEVICE USED FOR LEAD PLATE TEST, SHOWING PLATE AND DETONATOR IN PLACE

of the plate at the point of contact with the base of the detonator there occurs a depression which is dependent for depth both upon the size and quality of the detonator. Radiating from this central depression or perforation, as the case may be, are numerous striations of fine dotted lines. These striations constitute the real index to the quality of the detonator and the explosive effect of its composition. Each dotted line is the result

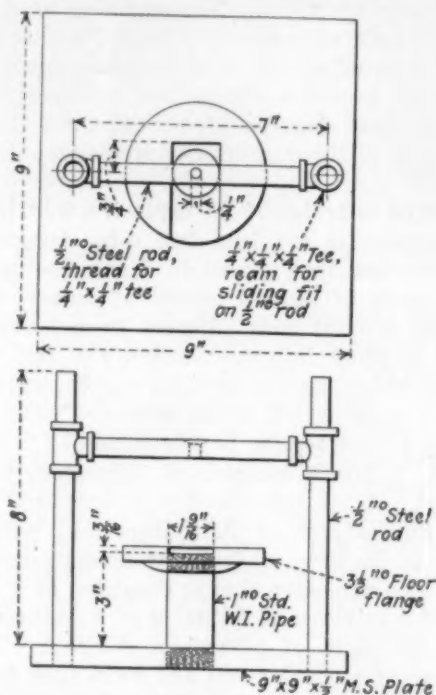


FIG. 2—TESTING DEVICE MADE FROM STANDARD PIPE FITTINGS

of a glancing blow inflicted by a single particle of the detonator shell.

The detonation of a good quality fulminate of mercury charge bursts the shell wall into innumerable concentric rings, each of which is, in turn, shattered into numerous small fragments. As the quality of a fulminate of mercury detonator is lowered, the size of the shell fragments becomes larger, due to a less brusque

TABLE I—TABULATED DESCRIPTION OF LEAD PLATES

Classification	Quality of Detonator	Indentation	Back Side of Plate	Radiations	Pittings	Remarks
A	Good	Deep, very often penetrating plate	Peeled	Fine Uniform	None	.....
B	Good	Deep, very often penetrating plate	Peeled	Practically uniform	Few Small	.....
C	Fair	Deep, very often penetrating plate	Peeled	Practically none	Large and deep	.....
D	Bad	Broad shallow	Not peeled	None	Large and deep	.....
E	Bad	Small, shallow	Not peeled	None	Large and deep	Often broad ribbon-like markings on face of plate.
F	Bad	Small, shallow and covered by remains of shell	Not peeled	None	Large and deep	Bottom and part of shell wall left on plate

action of the explosive charge, and radial striations on the lead plate tend to be replaced by large pittings or splotches at irregular intervals on the face of the lead plate, these pittings being caused by the larger fragments. If the detonator is of a very low quality, due to prolonged exposure to moisture, a defective grade of fulminate, a faulty mixture or any other cause, so that it may be practically worthless for detonating commercial powders, it will not shatter the shell into numerous small fragments, but will merely rupture the casing into a small number of broad strips. Consequently, with this detonator there are neither striations nor pittings, but instead, a few broad, ribbon-like impressions radiating from an almost imperceptible depression where the detonator was in contact with the lead plate.

STANDARDS FOR LEAD PLATE TESTS

As a matter of convenience, the various graduations of quality are classified according to six different standards, which are, in turn, designated by the first six letters of the alphabet, A being taken as 100 per cent and F as zero per cent quality. Fig. 3 shows a set of standards which represents the best judgment avail-

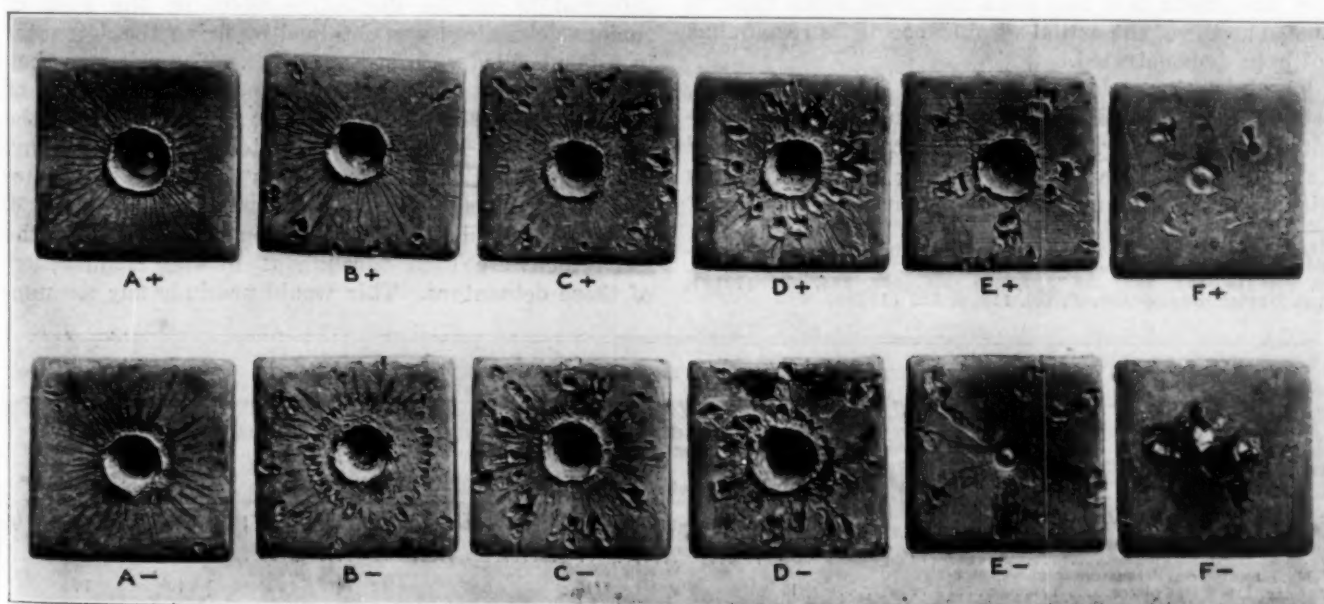


FIG. 3—SET OF STANDARD LEAD PLATES

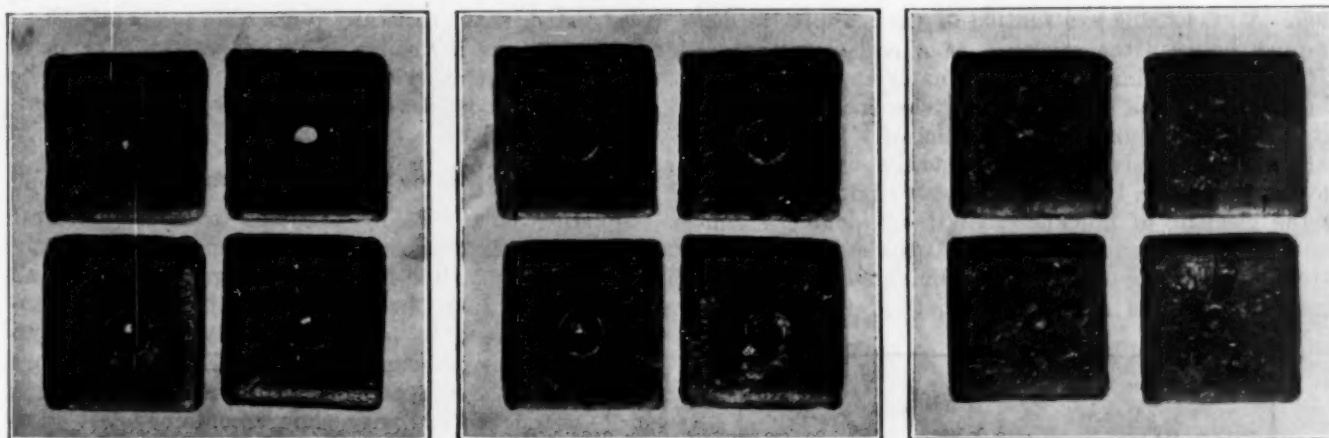


FIG. 4—REPRESENTATIVE LEAD PLATE TESTS OF COMMERCIAL DETONATORS USED IN DYNAMITE DETONATING
Test 1 Test 2 Test 3

tion that the variations in fragmentations could be attributed to variations in hardness or in the degree of annealing of the shells—a point which is further considered in a later section of this article.

The significant result of the various dynamite-detonating tests may be summarized as follows:

1. Detonators, giving A to C lead plates inclusive, are suitable for detonating commercial explosives. Although it was not possible to distinguish between these classifications in detonating value, there is no doubt that detonators giving A plates are somewhat superior to C detonators. A possible explanation of the difficulty in distinguishing between the efficiency of these classifications is given later. At any rate, a preponderance of C plates in a lot of detonators indicates a general state of deterioration which may soon lead to a lower quality detonator, of questionable efficiency.

2. Detonators giving E to F lead plates may detonate extremely sensitive dynamites, but are useless for ordinary grades of commercial explosives. Furthermore it is doubtful if even the most sensitive explosives may be detonated to their maximum efficiency with a detonator of this classification.

3. Detonators of the intermediate classification of quality, giving D lead plates, should be classed with E and F lead plates with respect to initiating value.

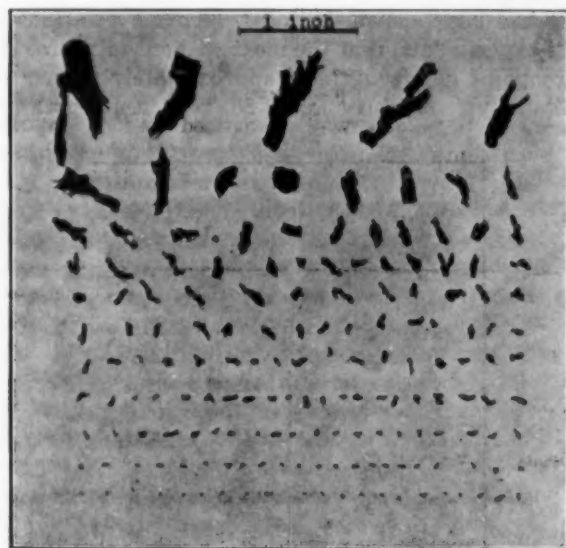


FIG. 5—DETONATOR SHELL FRAGMENTS FROM NO. 6 COMMERCIAL DETONATOR USED IN DYNAMITE-DETONATING TEST 1

Several attempts were made to prepare D detonators, but it was found that when D quality was attained the lot would also contain a large number of E to F detonators and it was impossible to confine the deterioration to the D stage. Therefore, if for no other reason, D detonators may be condemned because of bad company.

FACTORS INFLUENCING DETONATION OF EXPLOSIVES

It is not within the scope of this article to discuss the theory of detonation, but in order to indicate an agreement between the lead plate test and the modern conception of the mechanics of detonation, reference will be made to a few generally accepted theories.

Commercial explosives are brought to a state of explosion by the generation of a sudden impulse by the detonator. In its ultimate analysis this impulse consists of an enormous local application of heat, but for practical purposes it may be observed that two distinct factors enter into the development and application of this impulse. These are quickness or brisance, and strength. In a well-designed detonator it is impossible to isolate these two factors, but both properties must be present in correctly balanced proportions, otherwise an inefficient detonator will be obtained.

Velocity of the chemical reactions involved is a function of quickness, while the total volume of the gaseous combustion products is a function of strength. Of these two properties quickness is by far the more important. In fact, it is conceivable that the element of strength is of importance only in that it sustains for an instant the concussion produced by the initiating impulse, and thereby tends to compensate for the dissipation of explosive energy up to and during that instant of application. Many compounds might be cited which excel fulminate of mercury in strength but which are useless for detonating purposes; also many compounds might be mentioned which excel in quickness but which are vastly inferior to fulminate in initiating value.

The lead plate test is essentially a measure of quickness. Strength may be estimated by either the modified Trauzel block⁴ test or the sand test.⁵ The reduced efficiency of detonators having impaired brisance or quickness is clearly demonstrated in the dynamite-detonating tests above in which E to F detonators were

⁴Colver, "High Explosives," p. 552 (1918).

⁵Storm and Cope, "The Sand Test," Bureau of Mines Technical Paper 125 (1916).

used. A reasonable explanation of the inability to distinguish between the efficiency of A and C detonators is that in an ordinary No. 6 detonator there is always a great excess of the strength element. Formerly, detonators containing but a fraction of a No. 6 charge were used extensively. The presence of this great excess of strength tends to mask any slight diminution in the element of quickness. Without doubt, a similar series of dynamite-detonating tests on No. 3 detonators (containing 0.54 g. of a fulminate-chlorate mixture) would reveal a lowered initiating efficiency with

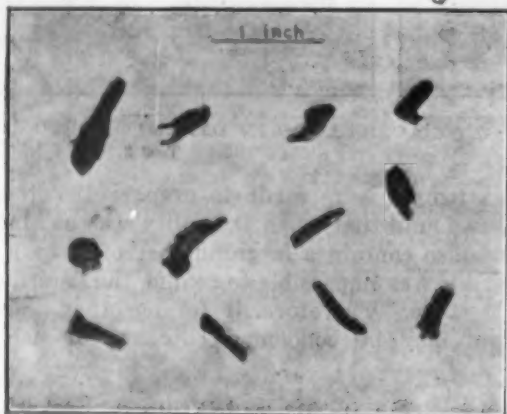


FIG. 6—DETONATOR SHELL FRAGMENTS FROM NO. 6 COMMERCIAL DETONATOR (WET) USED IN DYNAMITE-DETONATING TEST 3

each descending classification of lead paste. Since, however, No. 6 detonators comprise the bulk of the commercial article (in many countries it is illegal to market a detonator weaker than No. 6) all tests were confined to this grade.

FACTORS AFFECTING EFFICIENCY OF DETONATORS

An intensive study of the lead plate test would be incomplete without a consideration of the various factors which affect the efficiency of detonators as revealed by the lead plate test. The more important of these factors will be briefly reviewed in the following order:

1. Size of charge.
2. Moisture.
3. Potassium chlorate content.
4. Indentation of shells.
5. Hardness of detonator shells.

As was pointed out in a previous section of this article, the lead plate test is a measure of quickness rather than strength. The element of quickness in fulminate of mercury detonators does not vary greatly with the size of charge. Therefore the lead plate test does not indicate variations in weight of charges. This is demonstrated by the lead plates of No. 8 commercial detonators in Fig. 7. A No. 8 detonator contains just twice the charge of a No. 6 detonator.

It is true that, all other conditions being the same, the indentation in the center of the plate increases in size with the size of the charge. As the indentation is dependent on other factors also, and since the most pronounced variations are but slight, this is not a reliable index of weight of charges even in the hands of the explosives expert. It is gratifying to note, however, that under modern conditions of manufacture the tendency to produce undercharged detonators is rather remote. Reliable manufacturers build their charging machinery to deposit a standard charge and, when once

constructed, it is practically impossible to operate these machines so as seriously to "short-weight" the detonator. Thus it is evident that this limitation of the lead plate test does not constitute an objection to its universal application.

EFFECT OF MOISTURE

Moisture is universally admitted to be the greatest enemy of efficient detonators. This one factor is without doubt responsible for a very large majority of all detonator ills. An almost imperceptible moisture content is sufficient to impair seriously the ability to detonate commercial explosives. The E to F detonators used in the above dynamite tests were taken from a lot in which the explosive charge contained less than 1 per cent of moisture, while the moisture content of B and C detonators is scarcely weighable. Although the hygroscopicity of the potassium chlorate content is usually blamed for any tendency to take up moisture, the presence of a deliquescent salt is not a prerequisite for deterioration in wet storage. A fulminate charge absorbs sufficient moisture from condensation and capillary action to cause a rapid decline in efficiency under certain conditions. F detonators have been produced in two days storage in a humid room during certain summer seasons when there have been extreme changes between day and night temperature. Similar conditions prevail in many mines and most mining engineers are beginning to realize the importance of the "gospel of dry detonators." In addition to being urged to keep his detonator in a dry place, the blaster should be provided with facilities for making lead plate tests and encouraged to check up the efficiency of his detonators from time to time. Such a program would eventually yield big returns for the user, and also, indirectly, for the manufacturer of explosives.

EFFECT OF POTASSIUM CHLORATE CONTENT

Straight fulminate of mercury is seldom if ever used for detonator charges. This is due to the fact that, by itself, this compound is deficient in certain elements necessary to produce the maximum volume of combustion products, or, in other words, the maximum strength. Potassium chlorate is now used almost exclusively for the purpose of supplying this deficiency and it has been shown, both by chemical equations and actual experiments, that the most efficient mixture, from a standpoint of strength, is approximately 80 per cent fulminate of mercury and 20 per cent potassium

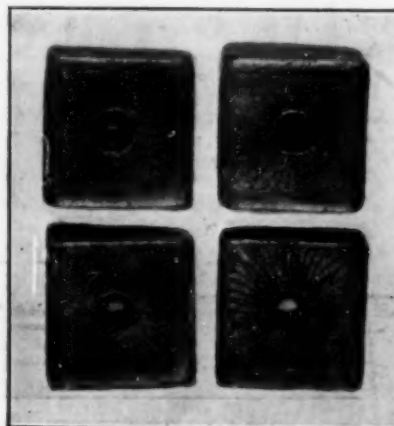


FIG. 7—LEAD PLATES FROM TESTS OF NO. 8 COMMERCIAL DETONATORS

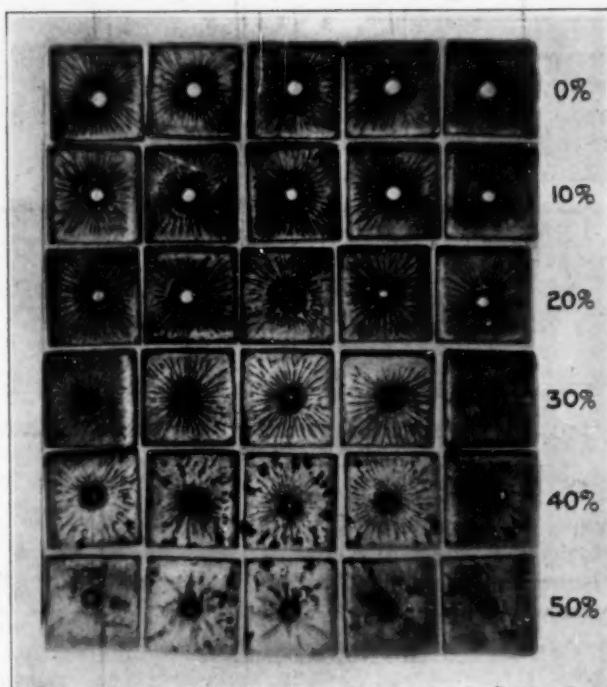


FIG. 8—EFFECT OF VARYING POTASSIUM CHLORATE CONCENT (0 TO 50 PER CENT) IN NO. 6 DETONATORS

chlorate. The admixture of potassium chlorate in large quantities tends to detract from the element of quickness as indicated by the lead plate test, but without doubt the considerable increase in strength from the admixture of 20 per cent potassium chlorate more than compensates for any diminution of brisance. Fig. 8 shows the effect on detonators, as indicated by the lead plate test, of varying the chlorate content from 0 to 50 per cent.

EFFECT OF INDENTATION OF SHELLS

It is quite generally admitted by manufacturers of detonators that the efficiency may be modified by the shape of the detonator shell base. The shells of most commercial detonators bear a conelike indentation which tends to improve the quality of the lead plate both by rendering the radiations finer and more uniform and by causing a deeper indentation. Numerous explanations have been proposed for this improvement. Most of these explanations have been vague and fanciful and probably justly so, because it is very difficult to make accurate conjectures on such minute details in the mechanics of explosives.

In order to ascertain whether or not this indentation actually effected a more pronounced explosive action, or if the improvement were only superficial, several experiments were made which yielded rather interesting results. Two cartridges of 60 per cent gelatine dynamite 2x8 in. were placed on end on steel plates 5 in. square by 1 in. thick. Each steel plate was supported on a short section of wrought-iron pipe 2 in. in diameter, which, in turn, was placed on a rock foundation. A conelike indentation about $\frac{3}{4}$ in. in diameter by 3 in. deep was made in the lower end of one cartridge and the other cartridge was left intact. Both were detonated with No. 6 detonators.

The appearance of the steel plate after the shot indicated that the explosive effect had been greatly concentrated at the base of the "indented" stick of dynamite.

In Fig. 9 A and B show the upper sides of the plates on which the indented and unindented sticks of dynamite, respectively, were detonated, while C and D show the reverse sides of the same plates in the same order.

In another series of tests made in connection with the effect of the detonator indentation, a number of commercial detonators were tested on lead plates, one half tested as received and the other half with the indentation filled with putty. The results (see Fig. 10) indicate that even though the indentation be filled with a plastic material, as is the case when the detonator is imbedded in a cartridge of dynamite, the advantage of this indentation is not abrogated.

But even after demonstrating that the indentation does effect a more concentrated explosive effect the task of presenting a suitable explanation remains. The diagram in Fig. 11 is intended to illustrate the lines of explosive force radiating from the interior surface of the indentation at the instant of detonation. These lines of force, or "explosive waves," always travel from the surface of the explosive by the shortest route—i.e., at right angles with respect to the surface of the explosive. Thus it is evident that in a perfect indentation—i.e., a 45 deg. cone, every line of force must collide with another line of force coming from the other side of the cone, the place of collision being the line of center. The result of these countless collisions, taking place simultaneously, is an added concussive effect or a greater concentration of explosive effect. A well-known example of a similar effect may be found in the ordinary Dautriche lead bar method of determining the velocity of detonation of powders.⁶ An explosive wave is induced at the opposite ends of a small column of TNT. At the point where these waves collide a tremendous

⁶Dautriche, *Compt. rend.*, vol. 143, p. 641 (1906).

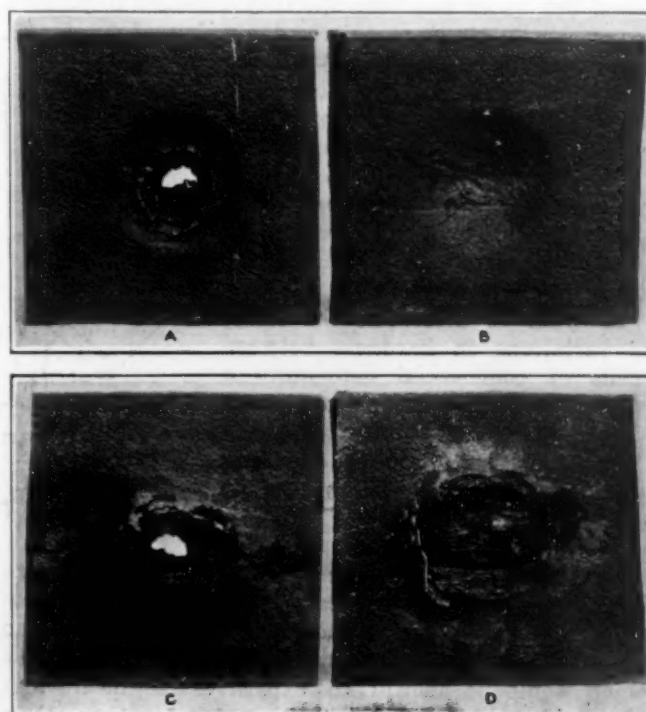


FIG. 9—COMPARATIVE EFFECT OF TWO CARTRIDGES OF 60 PER CENT GELATIN DYNAMITE ON STEEL PLATES, 1 x 5 x 5 IN.

A and B—Indented and unindented cartridges, respectively. C and D—Reverse sides of plates, in same order.

concussion is produced, the effect of which may be discerned even on the reverse side of a lead bar $\frac{1}{2}$ in. in thickness.

EFFECT OF HARDINESS OF SHELL

One of the very few objections which have been advanced against the lead plate test, and this is merely an imagined fault, is the belief that the quality of the test plate is greatly affected by the hardness or the softness of the detonator shell, thereby making possible the masking of a defective explosive composition by

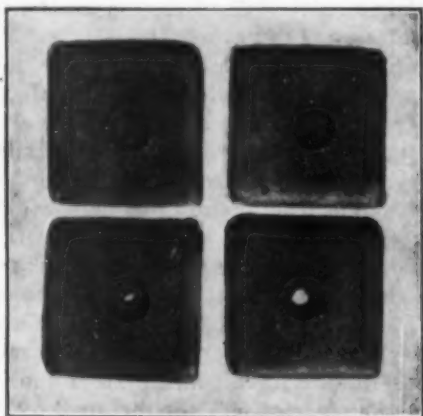


FIG. 10—LEAD PLATE TESTS ON NO. 6 DETONATORS WITH INDENTATION FILLED WITH PUTTY

using shells that are slightly harder or softer than normal. The fallacy of this assumption was demonstrated by the following experiment:

No. 6 commercial detonators were prepared using (a) gilding metal¹ shells that had not been annealed during any of the drawing operations and which represented an unusually high degree of hardness, giving a Shore scleroscope value of 58 to 60, and (b) shells of the same metal but which had been specially annealed to produce a soft shell, giving a scleroscope value of 36 to 38. Lead plates from both lots of detonators are shown in Fig. 12. These lead plates indicate that in a good quality detonator the resistance offered by the shell wall to the explosive force is so nearly negligible that the widest possible variations in shell hardness do not noticeably affect the disruptive action.

In order to determine the range of variations in hardness between shells of commercial detonators a large number of scleroscope tests were made on a number of shells from detonators of the four leading manufacturers. The following four averages were obtained: 40, 41, 43, 44.

An attempt has not been made to cover the entire field of commercial detonators. Many points of theoretical interest might be included, but it has been the aim of this article to give only actual experimental data which would be helpful to explosives engineers and others who are interested in results rather than theories. Without doubt, a more intelligent and a more extensive application of a reliable detonator test will

¹Gilding metal is the term applied to a copper alloy of approximately 90 per cent copper and 10 per cent zinc, which is used almost exclusively for detonator shell casings.

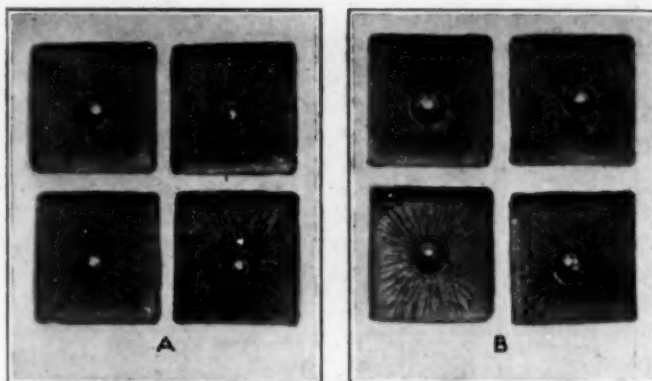


FIG. 12—TEST PLATES FROM NO. 6 COMMERCIAL DETONATORS

A—Annealed shells

B—Unannealed shells

do much to promote efficiency and safety in the use of explosives.

"Know your detonator" should be the adopted slogan of every user of industrial explosives.

ACKNOWLEDGMENTS

R. L. Hill and R. M. Cook have given much valuable aid in preparing the material for this article. Particularly the writer is indebted to Mr. Hill for helpful suggestions in conducting the various tests and in coordinating the results, and to Mr. Cook for the dynamite-detonating tests.

Liquid Soaps From Coconut Oil

BY MICHAEL DONIGER

Liquid soap may be described as an aqueous solution of soap, more particularly of a neutral potash soap. Its normal ingredients are water, glycerine and the potash soap of coconut oil. To be sure, liquid soap can be prepared from oil other than coconut, but it may be safely said that in most of these products consumed at the present time coconut oil is the fatty base, either singly or as the major component. This is not only because the properties of coconut oil fit it admirably for this purpose, but also because its cost is generally below that of any competing oil.

Ordinary solutions of soap in water are cloudy; properly made liquid soaps are clear, transparent and sparkling. These desirable properties depend to a large extent upon the presence of glycerine, alcohol or cane sugar in the finished product, but there are also certain important steps in the manufacture of this product which materially affect these characteristics.

PREPARING A CLEAR PRODUCT

A liquid soap prepared from coconut oil and containing 35 or 40 per cent of anhydrous soap will remain clear and transparent for an indefinite period at a temperature of or above 60 deg. F. If 40 or 50 deg. F. is maintained for a few weeks, however, soap crystals will gradually be forced out of the solution. These flocculent crystals, consisting largely of the soaps of lowest solubility, rise to the top rather slowly. Under these conditions the solution acts like one that is supersaturated, and by the agency of heat alone it is difficult to dissolve the crystals and thus re-form a clear solution. As long as the temperature stays at summer heat and the proportion of glycerine naturally occurring in the soap is sufficiently great, a liquid soap that



FIG. 11—DIAGRAM ILLUSTRATING THE CONCENTRATED EXPLOSIVE EFFECT AT BASE OF INDENTED DETONATOR

will remain clear and transparent can be prepared without the aid of any alcoholic clarifier. The first-named condition, however, is generally impracticable and the manufacturer is forced either to add glycerine or alcohol or else turn out a cloudy product. Glycerine is a valuable addition, since it has emollient properties; alcohol is of additional value because it commonly serves as the perfume carrier. Cane sugar, on the other hand, with its total lack of detergent properties, and its stickiness, should be used only in the cheapest goods.

CAUSE OF CLOUDINESS

Another cause of cloudiness is the presence of insoluble soaps, more particularly the lime soaps. In contradistinction to the turbidity caused by the precipitation of soda and potash soaps, the insoluble soaps sink to the bottom of the liquid and must be separated by filtration or sedimentation rather than by the use of an alcoholic clarifier. If the manufacturer uses distilled water, practically no insoluble lime soap will be formed. The expense is generally prohibitive, however, and the best procedure is to use a good soft water, and if a clear product is wanted, to filter the liquid soap or permit it to settle in a tank.

OTHER MANUFACTURING REQUIREMENTS

It is essential that a good quality of caustic potash be used. The commercial 88 to 92 per cent grade is dissolved in the proper proportion in a covered iron tank and the insoluble impurities permitted to settle. After a short while the clear, supernatant liquid can be siphoned off and used.

OPERATIONS IN LIQUID SOAP MANUFACTURE

Liquid soap manufacture may be said to involve two operations: Preparation of the soap paste and the solution of this paste in the liquid. The paste soap, which is made by the usual procedure of the soapmaker, resembles bleached petrolatum in appearance. If a pale liquid soap is desired, only the best raw materials are permissible and the soap paste should be made by the so-called cold process. This manner of treatment requires great care in order to insure complete saponification; otherwise the soap paste will gradually turn yellow.

SELECTION OF OIL IMPORTANT

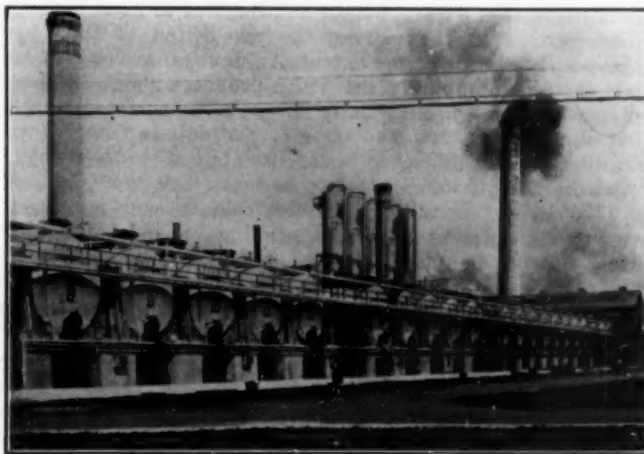
Since the oil used is one of the most important considerations, care should be taken in its selection. A good grade of coconut oil is of light color, free from objectionable odor, low in fatty-acid content, and contains practically no impurities. The ordinary Manila grade of oil, which is dark in color and has a strong empyreumatic odor, serves very well for the cheapest grade of liquid soap. Better qualities of oil are used, however, for the higher grade products. An oil of Cochin quality will furnish the base for such a product. A very superior liquid soap, practically water-white, clear and transparent, with an anhydrous soap content of 40 per cent and quite viscous, is made of an oil, the fatty-acid content of which has been reduced to about 5 per cent. Such an oil is pale yellow in color—ten yellow and one and a half red—on the color tester. Some soapmakers prefer to use refined edible oil for the highest grade goods, but this serves no better purpose than the cheaper oil and, in addition, is harder to saponify.

Brooklyn, N. Y.

Synopsis of Recent Chemical & Metallurgical Literature

Recovery of Gasoline From Uncondensed Still Vapors.—D. B. Dow, petroleum engineer of the Bureau of Mines, has recently completed a study of the different processes for the recovery of gasoline from uncondensed still vapors. This has been published in mimeographed form as Serial 2,344, *Reports of Investigations*, April, 1922. He estimates that 50,000,000 gal. of gasoline was recovered from uncondensed still vapors at refineries in 1921. Application of the system to all refineries would give a possible gasoline recovery by this method of 170,000,000 gal. yearly. Space limitation prevents giving a detailed account of this interesting, illustrated report, but an attempt is made in the following paragraphs to summarize briefly its salient features.

In the distillation in refineries appreciable amounts of the vapors are not condensed by the ordinary condensing equip-



BATTERY OF TWENTY CRUDE OIL STILLS CAPABLE OF HANDLING 10,000 TO 25,000 BBL. PER DAY.
COSDEN & CO., TULSA, OKLA.

(Photo by Bureau of Mines)

ment. The amount of vapor remaining uncondensed depends upon the following factors: (a) The amount of uncondensed vapors is proportional to amounts of gasoline produced. Other conditions being equal, more uncondensed vapor will be lost from a refinery which has increased the gasoline yield from crude by installing cracking stills than in a skimming plant which obtains only the gasoline present in the natural state. (b) A crude oil which gives a very volatile gasoline will lose more from uncondensed vapors than will a crude which contains gasoline of low volatility. (c) Summer losses due to uncondensed vapors are higher than winter losses. (d) The higher the temperature of the stream the greater will be the amount of uncondensed vapor. The stream temperature is directly dependent upon the temperature of cooling water and coil surface.

Experiments show that with stream temperatures exceeding 85 deg. F. the volumes of uncondensed vapors become increasingly large. Experimental data and plant data are given in the report which show effects of varying conditions of temperature.

A survey of 13 refineries of the United States which recover the gasoline from uncondensed vapors shows: A total crude charge for these refineries of 355,486 bbl. per day; a recovery of gasoline from uncondensed vapors of 128,651 gal. per day, which gives an average recovery of 0.444 gal. of gasoline per barrel of crude, or a recovery of 1.05 per cent of crude as gasoline which would otherwise be lost.

In operating a recovery plant on uncondensed vapors, one of the methods used for collecting vapors is as follows: A small vacuum is held on run-down lines where the vapors are

trapped off by means of goosenecks. This gas passes through traps which remove any condensate carried in the lines. The vacuum is held by either the intake of a compressor or in larger installations by means of an exhaust. When gas of high sulphur content is encountered, a unit for the removal of sulphur must be installed. This is accomplished by scrubbing the gas with a solution of caustic soda or suspended solutions of oxides of iron or lime.

In recovering gasoline from still vapors several different processes can be used: (a) The compression process is the more common, and consists of compressing the gas to a high pressure and cooling. This condenses the gasoline vapors and does not materially affect any permanent gas which may be present. (b) The absorption process consists of absorbing gasoline from the gas by passing it through a lower gravity distillate. When naphtha is used as the absorbent the naphtha is raised in gravity to the point where it may be marketed as gasoline. When a heavy gas oil distillate is used, the gasoline is separated from the gas oil by distillation. (c) Combination of the two methods is made use of when the gas after compression is passed through absorption towers.

Atmospheric temperature is an important factor in the production of gasoline from uncondensed refinery vapors. It is found that during winter months, due to more complete condensation of the vapors, the production of the "gas" plant will fall off to some extent. An unusual example of this is a certain skimming plant which produces about 6,000 gal. of compression gasoline daily through the summer months, but drops to as low as 500 gal. per day in the winter. Ordinarily, the difference is far less, but there is always a tendency for production to drop in cooler weather.

The cost of installing recovery plants will necessarily vary with different plants, depending on local conditions such as the distances between different stills which are sources of gas, the nature of gas, especially in regard to sulphur content, and the plant efficiency. However, a cost of approximately \$15 per gallon of gasoline (daily capacity) should be sufficient. The operating cost of the gas plant is relatively low.

Refining of Corn Oils.—The preparation of edible oil from crude corn oil is described fully by A. F. Sievers and J. H. Shrader of the Bureau of Plant Industry, Department of Agriculture, in Department Bulletin 1010, which was issued during April. Extended experimental results are given on refining by treatment with caustic, bleaching with fullers earth and deodorizing with steam.

Two methods of refining average corn oil are found to be about equally satisfactory. The soapstock obtained in refining corn oil is soft and slimy, and special means are necessary to harden it. In one of the proposed methods a large excess quantity of caustic is used, while in the other the same result is obtained by adding soda ash after the break. A maximum temperature of 55 deg. C. is recommended in the refining of corn oil.

The value of the chemicals used and the oil lost in the treatment is 0.628 cent per pound of neutralized oil with method 1 and 0.564 cent with method 2, of which more than 80 per cent is represented by the loss of oil.

The oil is bleached with fullers earth according to the method generally used. Not less than 5 per cent of earth must be used. Corn oil does not bleach as much by this treatment as some of the other vegetable oils. The cost of the materials used and the oil lost in this bleaching process is about 0.22 cent per pound of bleached oil, of which approximately half represents the value of the oil lost.

The oil is deodorized by being blown with steam for several hours at temperatures above 400 deg. F. under reduced pressure.

The general arrangement of a refinery equipped to handle two batches of 25,000 lb. of oil a week is described and the passage of the oil through the several processes is discussed.

The cost of refining corn oil in such a plant as here described is found to be approximately 1.6 cents a pound. This cost figure was obtained by determining as nearly as possible the several charges for chemicals, oil losses, fuel, labor and overhead. The cost of the equipment, exclusive of the building, is estimated at \$40,000.

Book Reviews

A DICTIONARY OF APPLIED CHEMISTRY. By Sir Edward Thorpe, assisted by eminent contributors. Revised and enlarged edition. Vol. 2, *Calculi-Explosion*. 717 pp., illustrated. New York and London: Longmans, Green & Co. Price \$20.

The second volume of the new edition of Sir Edward Thorpe's Dictionary of Applied Chemistry is compiled by many of the same eminent contributors who have made the previous edition justly famous. There are some new names which would be known better in Great Britain than here. To the American reader that is, I think, a most disappointing thing about the admirable collection. There are not many names well known to the American chemical engineer, and this brings us to a point in which we find ourselves in agreement with the reviewer of the first volume. It is not unnatural that the contributors should be unfamiliar with American practice in chemical engineering, but from the American point of view it is one significant lack in the book.

The editor of such a series of essays must find himself in a very difficult position in endeavoring to accord proper weight to some of the contributions. To disagree with such weighting in certain instances is, of course, inevitable and merely the expression of an opinion that such and such a subject should not receive so much importance. In illustrating this particular point, there is a course in a certain college, part of which is devoted to a very special research problem carried out by the professor in charge while he was a student in Europe. The particular subject has very little to do with the general subject matter of the course but receives undue emphasis because of the peculiar make-up of the professor's ego. The Dictionary of Applied Chemistry is peculiarly fortunate in having a man whose experience is so wide and whose judgment is so sane as Sir Edward Thorpe. It would be difficult to find a man better qualified to proportion the space necessary for adequate discussion.

A general and gentle criticism may be suggested that too little space is given over to types of equipment and too much to theoretical chemical discussion. Specifically, it would seem to be more desirable in a Dictionary of Applied Chemistry to devote much more space to the subject of evaporation and evaporators and somewhat less to the general subject of carbohydrates. Evaporators as examples of chemical equipment have a tremendously wide use in almost every industry, and the dictionary discusses only the principles lying back of three designs now on the market. Considerable work, particularly in this country, has been done on the improvement of evaporator design, and it would seem that such discussion could be included desirably in the dictionary. Similarly, some of the discussion on carbohydrates has to do with rare sugars and their properties, the use of which is extremely limited and the general interest in which is rather negligible.

In like manner the American reader will be a little confused by the article on chlorine, for example, wherein the British methods of manufacture alone are taken up and no American operations are discussed. The technical discussion of the processes for chlorine manufacture is, however, entirely adequate.

It is to be sincerely hoped that the reader of this review will understand that my enthusiasm for this great work is very real. Consulting and operating chemical engineers who are not familiar with this would do well to look it up at once. In my experience, which has been confirmed by several acquaintances, the dictionary will supply a very adequate basis for a preliminary search on a subject upon which much information is desired and will frequently supply all the information that is necessary.

Some one has run off with the fourth volume of the older edition and I am extremely anxious to have the new edition come out and supply that missing link. That will only indicate my affection for the "mag. op."

CHARLES WADSWORTH, 3d.

LEHRBUCH DER METALLOGRAPHIE. By Prof. Gustav Tammann. Second Edition, 1921. 420 pp. 219 illustrations. Leipzig: Leopold Voss. 110 marks.

It cannot but be regarded as significant of a definite trend in metallography that in the new edition of "Lehrbuch der Metallographie," by Dr. Gustav Tammann of Göttingen, an entirely new viewpoint has been maintained. Like the first edition, it contains an extraordinary compilation of information concerning physical metallurgy. There are many of the chapters of the earlier edition which are again presented in substantially the same way; the additions are not alone in the form of appended or inserted chapters, but one finds the new material very effectively distributed throughout the whole treatise.

The new viewpoint is concerning the atomic arrangement in metals and alloys. Much of the actual data introduced is contained in an article entitled "The Chemical Properties of Alloys," which appeared in *Metallkunde* in September, 1921.

Tammann's own preface to the second edition may be read as follows: "The recent advance in the atomistics of crystalline substances does not deserve to remain unremarked in a domain which of late has leaned exclusively toward thermo-dynamic equilibria. Accordingly, the chapter on recrystallization is presented with a new atomistic principle and the chapter on the chemical and electrochemical properties is based on an atomistic concept of the arrangement of two kinds of atoms in a space lattice."

The metallurgist familiar with the metallography of useful metals might possibly expect a discussion of atomic arrangement to be uninteresting and impractical, but he will find these new chapters attractive because of the logical manner in which the "atomistics" of metals are associated with well-known properties—particularly chemical and electrochemical behavior—which, of course, constitute the basis of corrosion.

The mention of atomic arrangement instantly calls to mind the crystallograms made by the diffraction of X-rays by atomic planes. Prof. Tammann really has had available very little crystallographic data resulting from the application of Röntgen rays to metallography. Yet his inferences from other sources of information have been so accurate that in general they are in perfect accord with the X-ray data obtained in this country. At any rate, after reading the book the student will have a much more realistic impression of the state of existence of the metals in alloys and many words which now call to mind only microscopic appearance or physical properties will take on a mechanical significance.

The mechanism of solidification from the melt is lucidly described, and even if one does not feel inclined to agree entirely with the presentation, it nevertheless is an attractive hypothesis. Prof. Tammann says that the atoms of the melt are isotropic, but become anisotropic upon cooling. This change is prerequisite to their alignment in a space lattice. The rate of formation of the anisotropic nuclei and the rate of crystal growth from the nuclei determine the grain size. In the case of amorphous glasses the rate of formation of nuclei is so very low that before an appreciable number are started the temperature may be dropped to a range where none whatever form. Reheating in such cases either starts new nuclei or may reduce the viscosity so that an ordinary liquid results.

It is in the discussion of solid solutions that the matter of atomic distribution is chiefly stressed. The picture of the inherent nature of solid solutions offered in this country by one of the present writers is corroborated entirely by Prof. Tammann. The atoms of the solute replace atoms of the solvent in its lattice with only a change in the size or parameter of the lattice. Upon solidification of a binary solution the atoms of both metals betake themselves to certain lattice positions, but they are not arranged in the same proportion in all parts of one grain nor are two adjacent grains necessarily of the same constitution. Above the recrystallization range of temperature a rearrangement or "place-interchange" occurs, and the two kinds of atoms become distributed as symmetrically as possible. When several modes of symmetrical arrangement are possible for a given composition, that one which gives the greatest number of atomic lines containing both kinds of atoms is built up. By

this method of arrangement the smallest possible portion of the lattice will show the average composition of the whole mass of alloy. Obviously there are some ratios which will produce relatively simple distributions, notably in the regular system 12.5, 25.0, (37.5), 50.0, (62.5), 75.0 and 87.5 atoms per cent.

The proof of this is ingeniously shown by the very abrupt change in electrochemical behavior in many alloys at these compositions. Reagents which vigorously attack one constituent and are inert toward the other usually show action up to a certain content of the more noble metal and almost no action for higher concentrations. A great variety of reagents in contact with many alloys are cited and the results are tabulated. As an example, nitric acid does not attack silver-gold alloys with more than 50.0 atoms per cent of gold, but completely removes all the silver from those with less than 37.5 atoms per cent. Between these percentages of gold content the action is linear with the composition. The 25.0 per cent composition limit holds for the action of weak oxidizing agents and palladium chloride on the gold-copper series. (Palladium chloride is decomposed by the gold-silver series up to 50.0 atoms per cent.) The matter of valence is most important in the location of these composition limits, and this fact is very logically explained. If the atoms of the two metals were distributed in the lattice at random, we should have the protective action of the noble metal conforming to the law of probability and there would be no abrupt steps in the function. This "composition-for-reaction-limit" study has resulted in what is probably the most plausible explanation of the absorption of hydrogen by palladium.

The possible space distributions for various compositions are comprehensively charted in the book. It is interesting to note that the regular arrangement of two kinds of atoms in a solid solution was discovered by X-ray analysis within the past year in this country. There is, of course, no very simple space distribution for a composition corresponding to 37.5 atoms per cent (ratio 3 to 8), and indeed this value rarely marks a reaction limit. Metals deposited simultaneously from an electrolyte do not possess the regular distribution of the two kinds of atoms (unless heated to the recrystallizing temperature) and consequently do not show the normal composition limits for reaction, but, like the amorphous glasses, do not possess this interesting property.

In discussing the possibility of the formation of an uninterrupted solid-solution series between two metals Tammann states definitely that they must both have the same type of space lattice. Since he accepts the evidence for the usual statement that copper and manganese, chromium and nickel, and alpha iron and nickel form completely isomorphous series, he includes all these metals in the face-centered cubic series. Actually it has been proved that chromium and alpha iron are body-centered cubic, unlike nickel, and that manganese is not isometric at all, but is of a complex type, probably hexagonal. In this country one of the present writers has shown that certain compositions in these so-called continuous solid-solution series are built up of the two distinct crystal types belonging to their component metals.

It is to be regretted that Prof. Tammann had not available a more complete knowledge of the verified space lattices of the elements, such as given by Hull. The choice of nomenclature used in connection with the description of the known types of isometric lattices of metals is unfortunate. The simple cubic is called the 8 point, the body-centered the 9 point, and the face-centered the 14 point. These numbers refer to the actual number of lattice points in any way involved in the arbitrarily chosen elemental cube of the structure. As a matter of fact, the three types respectively contain 1, 2 and 4 atoms per unit cube. The descriptive names used in English writings on atomic structure are certainly much better chosen.

A point which appeals to English-speaking readers is the remarkable freedom of the work from the ponderous, involved style found so frequently in German scientific writings. Altogether, the book is an admirable presentation of the physical chemistry of metals and the metallographist cannot shun the new viewpoint without hampering himself in his attempt to generalize the properties of metals.

EDGAR C. BAIN and STANTON UMBREIT.

Technical News of the Week

Current Events in the Chemical, Metallurgical and Allied Industrial Fields—Legislative Developments—Activities of Government Bureaus, Technical Societies and Trade Associations

Bills Before House Embody Acceptance of Ford Muscle Shoals Offer

The recommendations of a majority of the members of the Committee on Military Affairs of the House of Representatives in the matter of the Henry Ford proposal for the Muscle Shoals property is embodied in a bill introduced June 5 by Representative McKenzie, acting chairman of the committee.

The bill authorizes the sale of Plants No. 1 and No. 2 and the Waco quarry to Henry Ford and the lease of dams 2 and 3, including power houses and all hydro-electric and other equipment except the locks, for a period of 100 years.

Included in the property of the sale are all the lands, buildings and equipment of plants 1 and 2, the right to use all the patents, processes and designs which have been acquired and the sulphuric acid units now in storage on the premises. Mr. Ford would not be bound, however, to operate Plant No. 1 as a nitrogen fixation plant. The payment of \$5,000,000 may be spread over 5 years, the first payment of \$1,000,000 to be made on acceptance of the offer.

The annual rental for the plants is fixed at 4 per cent of the actual cost of acquiring land and flowage rights and completing dam and power houses. This amount does not include expenditures incurred prior to the approval of the proposal. Rental payments are to be made annually, the amount for the first 6 years after the development of 100,000 hp. being fixed at \$200,000 per year. The annual rental for dam No. 2 is placed at \$35,000 per annum, upkeep to be borne by the company.

WOULD BIND LESSEE TO WORK ON FERTILIZERS

The bill specifically states that the company must agree to manufacture commercial fertilizers at Plant No. 2 or such other plants as may be constructed, the annual production to have a nitrogen content of at least 40,000 tons of fixed nitrogen—the present capacity of Plant No. 2. It is also stipulated that the company will determine by research whether there may be produced on a commercial scale fertilizer compounds of higher grade and at lower prices than farmers and other users of commercial fertilizers have in the past been able to obtain, and to determine whether in a broad way the application of electricity and industrial chemistry may accomplish for the agricultural industry of the country what they have economically accomplished for other industries. If such methods be found they are to be reasonably employed.

As will be noted, the 100-year lease period which was the basis of much opposition to Ford's original proposal is retained, as is the original purchase price.

The main change in the terms of the offer is the exclusion of the Gorgas steam plant. Mr. Ford has expressly stated that he will stand or fall on his offer and that the exclusion of the Gorgas plant would be interpreted by him as the rejection of his offer.

ADDITIONAL BILLS

The minority of the committee's membership, which favors the unqualified acceptance of Mr. Ford's offer as amended on May 31, will submit its bill and report the latter part of the week. The majority report on its bill also will be submitted at that time. Two bills already have been introduced, proposing the acceptance of the Ford offer. One was introduced by Representative Wright of Georgia, a member of the committee but acting independent of the minority. The other was introduced by Representative Almon of Alabama, in whose district the property is located.

The Senate amendment to the War Department appropriation bill, by which \$7,500,000 would be granted for the completion of Dam No. 2, aroused some discussion in the House. Several members argued for its direct consideration by the House instead of by conference. The point at issue seemed to be an uncertainty in the minds of the Representatives as to the bearing of such an appropriation on the lease proposals which are now before the House. Representative Byrns of Tennessee held that the amendment would not affect the consideration of the lease offer. Others, notably Representative Green of Vermont, who is a member of the Military Affairs Committee, felt that a question of government policy is involved. The amendment was sent to conference, with prospects of open debate on the floor of the House upon its return.

Ford's "Secret" Fertilizer Process May Be Federal Phosphorus Co.'s Method

According to recent reports, the Federal Phosphorus Co., headed by Theodore Swann of Birmingham, is contemplating the removal of its plant from Birmingham to Jacksonville. T. L. Long, representing Mr. Swann, recently appeared before the city commission of Jacksonville and asked that Jacksonville give the company power concessions for the establishment of a factory on what he intimated would be a 10-acre site.

The electric furnace process for the manufacture of phosphorus from phosphate rock, coke, sand and iron borings¹ is supposed by many to be the "secret" electrical process to which W. B. Mayo, Henry Ford's chief engineer, referred when before the Senate committee, when he said that Ford could make cheaper and better fertilizer for the farmers of the nation. Certainly Mr. Long's statements to the Jacksonville commission gave this impression very pointedly.

It is claimed that the new process will give from 35 to 40 per cent of plant food, compared to about 14 per cent secured from phosphate rock by the old acid treatment.

Jacksonville's power rate is 2 cents per kw.-hr., with a downward sliding scale for large consumers. While the commission has not yet gone into a full consideration of the application it will probably be considered in the near future.

Edison Working on Potash Extraction

Some light on experiments which it is rumored are being made by Thomas Edison with potash, from deposits in east Tennessee, is shed by a letter from Mr. Edison to State Geologist Wilbur A. Nelson and made public by Mr. Nelson. The letter dated May 16, follows:

Your letter of May 10 has been received. Since I got some of the Cartersville potash slates the experiments have never ceased. One line of experimentation shows very promising results. The only trouble is, Can we manufacture on a large scale so as to compete with German potash? So far, it looks as if we could and also go them a little better. If we cannot quote a price at which they (the Germans) cannot sell, it will help the farmer very little. What is required is that he can get it very cheaply.

Can you send me a colored geological map of the region, say covering 250 miles in diameter, with Muscle Shoals as a center? If this map could not be furnished as a single map, it would do in sections.

Mr. Nelson explains that the Cartersville slates are named from the town of Cartersville, Ga., near which they are found. The deposit extends into Tennessee.

¹See CHEM. & MET. ENG., vol. 26, p. 726 (April 19, 1922).

Testimony Before Dye Investigation Committee Ends With Defence of Textile Alliance

Hearings before the Senate judiciary sub-committee conducting the dye investigation were concluded June 3 when A. M. Patterson, president of the Textile Alliance, appeared to rebut certain statements made by W. Paul Pickhardt of Kuttroff, Pickhardt & Co. At the close of this session Chairman Shortridge announced that at the present time there was no intention of holding further hearings and that the committee stood adjourned to meet again at the call of the chairman.

SAYS IMPORTER HINDERED ALLIANCE

Mr. Patterson attacked testimony delivered previously before the committee by William Paul Pickhardt, of Kuttroff, Pickhardt & Co. and criticised that firm for hindering in every way possible the efforts of the Textile Alliance, as the officially designated agency of the United States Government, to secure German dyes needed by American dye-consuming industries.

The German cartel had offered to sell its dyes to the Textile Alliance as a private concern, Mr. Patterson testified, but this offer was immediately rejected. The Alliance, he said, never had attempted to substitute German dyes for American dyes in use by consumers.

Petitions "ostensibly signed" by thirty mills which had been presented to the Senate Finance Committee at hearings held by that committee two years ago, Mr. Patterson said, had been prepared and circulated by Kuttroff, Pickhardt & Co., in "spite of numerous denials." "As a matter of fact," he added, "this was nothing more than a part of Kuttroff, Pickhardt & Co. propaganda."

"In carrying out our task for the government and the consumers," he said, "we had assistance of many importers, particularly Mr. Metz, but never of Kuttroff, Pickhardt & Co."

The petition in question, he continued, had been a "dead issue" for two years and is pertinent to the present discussion only because Mr. Pickhardt had introduced it in his previous testimony before the committee. "It purports to be a spontaneous expression of opinion of consumers, but it is not what it is supposed to be," he added. The petition protested against importation of dyes through any other than the "regular commercial channels."

The Reparation Commission had refused to deal with the Textile Alliance, or any importer as a private concern, the committee was told. The Department of State had terminated the arrangement whereby the Alliance was its officially designated agent to receive these dyes. This action was taken because the Department of State believed it did not have the power to continue the Alliance or any other organization as its agent. The Reparation Commission had notified this country that unless it designated some agency to receive such dyes as accrued to it under the treaty it could not continue to supply them after June 30, 1922.

"If nothing is done in the face of this situation," Mr. Patterson said, "the German monopoly will again be a monopoly as far as the 10 per cent of dye consumption needs which we must import."

PICKHARDT PRESENTS GERMAN OFFER

An offer of the German cartel has been made by him to the State Department and the Commerce Department, Mr. Pickhardt told the committee. This offer provided that the German cartel should supply the United States the needed quantity of dyes, not covered by the reparation dyes, at prices as low as if they had been secured under the present arrangement.

Chairman Shortridge questioned the efficacy of such an agreement and asked how it would be enforced. Mr. Pickhardt said he assumed it would be enforced in the same manner the treaty provisions were enforced. He denied a statement by Chairman Shortridge that the German cartel was controlled by the German Government.

Mr. Patterson declared that it was distinctly to the benefit of the American people to receive the reparations

dyes and expressed the view that the Department of Commerce should be designated as the agency to receive them. He stated that unless the government takes action, the supply will be cut off on the thirtieth of June.

There followed some discussion between Mr. Patterson and Mr. Pickhardt as to what would be the loss to the country in such event. Mr. Pickhardt repeated his previous statement that no loss would be incurred by the consumer inasmuch as the German cartel had authorized him to state that it would agree to supply at low prices whatever dyes might be lost through termination of the present arrangement. Mr. Patterson insisted that this proposal did not solve the problem. The Textile Alliance did not wish to continue as the officially designated importing agency for these dyes and it had repeatedly urged that this be taken over by the government itself, but that in all events, in order to safeguard consumers' interests, some action that will make continued receipt of the dyes certain should be taken prior to June 30.

TABLE OF DYE PRICES SHOWS STEADY DECLINE

Of interest in connection with the original purpose of this investigation—the alleged existence of an American dye monopoly, is a table recently issued by the Synthetic Organic Chemical Manufacturers' Association. The fact that no substantiation of the monopoly charges developed during the hearing is strengthened by the additional evidence of competition shown in the steady decrease in the price of nearly all American dyes in the past five years.

The table comprises 67 dyes of American manufacture, the tonnage production of which aggregates over 82 per cent of the total American production for the calendar year 1920.

It is particularly worthy of note that the depression in the prices of American dyes has taken place over a period during which competing dyestuffs of German manufacture were prohibited entry. The table shows the average price of each dye, each year, for a period of approximately five years, from January 1, 1917, through April 27, 1922. It also shows the percentage of decrease in the American prices over this period.

The vividness of these reductions is particularly emphasized in connection with the reduction in prices of the following colors produced in large quantities:

Indigo, produced by 12 American manufacturers, and which in 1917 had an average price of \$1.42 per lb., on April 27, 1922, sold for 30 cents per lb., a decrease of 79 per cent.

Sulphur black, produced by 3 American manufacturers, and which sold in 1917 at 60 cents per lb., on April 27, 1922, sold around 18 cents per lb., a decrease within that period of 70 per cent.

Direct black, EW, produced by 14 American manufacturers, and which sold in 1919 at \$1.04 per lb., on April 27, 1922, sold at 42 cents per lb., a decrease of 60 per cent.

Malachite green, produced by 6 American manufacturers, and which sold in 1917 for \$6.28 per lb., on April 27, 1922, sold for \$1.50 per lb., a decrease of 76 per cent.

Declines in the prices of other dyes range downward to one per cent in the price of acid yellow G. This dye, produced by two American manufacturers, was not put on the market in commercial quantities prior to 1921, when its average price was \$1.21 per lb. The market price of this dye on April 27, 1922, was \$1.20 per lb.

The comparatively small decreases in the prices of these newer American dyes as against those which have been produced for a longer time seems to indicate clearly that increased efficiency and lower costs result from extended experience in manufacture.

Japanese Trade in Fertilizers

Fertilizers imported into Japan during the fiscal year ended March 31 were valued at 121,800,000 yen. This was a decrease of 110,000,000 yen compared with the preceding year. The export trade also suffered a decline and in the past twelve months amounted to only 320,000 yen. This figure was over 2,000,000 yen less than in 1920.

Sentiment Strong for Dye Embargo— Manganese Put on Free List

While all plans had been made by Senate leaders to dispose of the dye embargo matter before the week of June 5, the discussion was permitted to go over for a week on the insistence of Senator King that he had been led to believe that paragraph 26 of the chemical schedule would be considered separately. Senator McCumber is at a loss to know just how such an impression was created, but in his desire to accommodate Senators and give ample time for such investigation as they are desirous of making, he granted the extension of time. It is regarded as practically certain, however, that the dye embargo will have been voted on before the end of the week of June 12.

At the time of this writing, it seems practically certain that the committee has the votes to retain the embargo provision in the bill. It is significant that Senator King is the only Democrat who has spoken against the measure. The Democratic opposition is lukewarm and it is known that some members of that party will vote for the embargo.

Perhaps the most significant development in recent weeks in the embargo situation came when Senator Frelinghuysen revealed that President Harding is squarely behind this proposal. Senator Frelinghuysen has led the fight for the embargo and in addition to his very convincing speeches on the floor of the Senate is credited with having convinced Senator Moses that there is more merit in the proposition than the latter formerly believed. The chances of the embargo were improved greatly when Senator Moses withdrew his active opposition.

CHEMICAL WARFARE DRAWN INTO DISCUSSION

Gas was brought into the debate only once. Senator Borah, in condemning a continuance of chemical warfare activities, admitted that other nations are going ahead with their scientific studies of the application of gas to warfare. Senator King attempted to prove that there was no connection between dyes and the national defense. His attention, however, has been called to the British report which points out and proves the exact part which the German dye plants contributed to military prowess. The point also will be made in defense of the embargo that the Chemical Warfare Service of our own army, without any thought of its application to a dye embargo, long has been studying the exact details of converting specific American dye plants to military uses in time of war.

KING'S ATTACK WITHOUT INFLUENCE

Senator King's five-hour set speech and his numerous but less lengthy tirades against the domestic dye industry in no way influenced the vote on paragraph 26, which was adopted just as soon as an opportunity was offered for the vote. In the course of the discussion Senator McCumber pointed out that Republicans do not believe in embargoes, but that an exceptional situation had arisen—so exceptional that even a Democratic President had recommended a chemical and dye embargo.

Paragraph 25, covering dyes, which was adopted some time ago, was returned to in order to permit Senator King to offer an amendment which was rejected, placing the duties on dyes in that paragraph at 50 per cent ad valorem, and 3½ cents per pound on dyes valued at not more than 10 cents a pound and 30 per cent ad valorem and 7 cents a pound on those valued at more than 10 cents a pound. The paragraph was then adopted as recommended by the committee.

Senator King offered an amendment changing from 60 per cent ad valorem and 7 cents per pound the duties in paragraph 26 as follows: 35 per cent ad valorem and 3 cents per pound on those valued up to 25 cents a pound; 35 per cent ad valorem and 5 cents a pound on those valued up to 50 cents a pound, and 35 per cent and 7 cents a pound on those valued at more than 50 cents a pound. The amendment was rejected after debate.

Senator King opposed the committee rates, saying they were the same on intermediates as on finished products and would amount to duties of 400, 500 or 600 per cent and on other allied products 100 per cent. He objected to the same

duty on dyes of varying prices. He had no objection particularly to the ad valorem duties, except that they were too high, but criticised especially the specific rate. His amendment readjusting the duties was rejected by a vote of 18 to 40, and the committee rate was then approved.

Senator King offered an amendment to strike out the provision that any article in paragraphs 1, 5, 35, 37, 56, 63, 79, 1578, 25, 26 and 1546 shall be assessed for duty or exempt from duty under paragraphs 25, 26 or 1546. The effect of this amendment would take out medicines and compounds from the paragraph giving the articles a duty of 20 or 25 per cent. Senator Smoot opposed the motion, saying the duties were recommended by the Tariff Commission, and the King amendment was rejected. The Utah Senator also offered an amendment fixing the highest instead of the lowest strength as the standard for dyes. It was opposed by Senator Smoot, who said the change would work an injustice. Senator King admitted the amendment might work an injustice and withdrew it with the understanding that he might renew it after consultation with those familiar with the dye industry. Paragraph 26 was then adopted.

MANGANESE PUT ON FREE LIST

The Senate again overrode its Finance Committee on the amendment which carried manganese ore to the free list. The vote was 19 to 35. The effect of the vote was to restore to the bill the House rates of 1 cent a pound on manganese ore or concentrates, carrying in excess of 30 per cent metallic manganese. The amendment was offered by Senator Nicholson of Colorado, who delivered a long speech in behalf of protection to the American manganese industry, which he said had been developed during the war and which should be protected against deposits of foreign countries which were worked more cheaply than in this country. The debate largely revolved around the question as to whether American deposits of manganese were sufficient to meet the requirements of the steel industry.

POTASH PARAGRAPH FACES FIGHT

It is becoming increasingly apparent that the duties on potash will not be accepted by the Senate without a fight. Propaganda against the duties is afoot and farmers in large numbers are writing to their Senators asking that they oppose the duty.

Some of those favoring the potash provision of the tariff bill contend that the German syndicate is back of the propaganda. On the other hand, the paragraph has the strength which goes with hearty committee endorsement and it squares with the Republican protection policy.

A new element has been interposed in the situation by the promising discoveries of potash in Texas. The farmers and business men in southwestern Texas are acting in a united and active manner in their support of the potash duty. Each member of the Senate and of the House of Representatives has been mailed a brief signed by "owners of potash beds in the State of Texas," in which the point is made that foreign producers have effected an international combination in restraint of trade and that the consumers in the United States will suffer in the end unless American sources of potash are developed.

Chemical Warfare Service Appropriation Increased in Senate Amendment

The Senate passed the War Department appropriation bill with the committee amendment increasing the appropriation for the Chemical Warfare Service from \$500,000 to \$750,000. Senator Borah of Idaho opposed the increased appropriation on the ground that it was not keeping faith with the armament conference in barring poison gas. By a vote of 46 to 22 the Senate adopted the increased appropriation and the measure now goes to the House for action on this and other Senate amendments.

An amendment was proposed by Senator Wadsworth of New York, chairman of the Military Affairs Committee, providing for the employ of draftsmen, chemists and chemical engineers in the office of the chief of the Chemical Warfare Service at Washington.

Mellon Institute Annual Report Shows Value of Scientific Research to Industry

The ninth annual report of the Mellon Institute of Industrial Research of the University of Pittsburgh brings out the extent of the valuable experimental work that is being conducted by the Institute. Although the Institute has never aspired to largeness in size, there are now forty-nine industrial fellowships, and additional fellowships will begin operation just as soon as the necessary facilities can be provided.

The total amount of money contributed by industrial firms to the Institute for the eleven years ended March 1, 1922, was \$1,995,922. During the eleven years the Institute itself expended approximately \$477,600 in taking care of overhead expenses. Eleven of the fellowships have been founded by associations, thus enabling the Institute to be of direct service to groups of industrial concerns instead of to individual companies.

DEMONSTRATING VALUE OF RESEARCH TO INDUSTRY

By the application of its system, the Institute has been able to demonstrate to American manufacturers and associations that industrial research, properly carried out, is profitable to them. It would be interesting to give here a statement concerning the financial gains which have been derived by donors as a result of the Institute's activities in their behalf. The executive staff is not privileged to release this information at the present time; but it may be noted in passing that 85 per cent of the problems accepted by the Institute for study from 1911 to 1922 have been solved satisfactorily from the donors' standpoints.

Among the investigations completed and under way at the Institute may be mentioned the following: Physical properties of glass; bread technology; citrus products; electrical precipitation; smoke investigation; pressed glassware; chemistry of petroleum; manufacture of carbon dioxide, carbon monoxide, hydrogen and nitrogen; composition flooring; fractional distillation; hydrometallurgy of copper; olefine gases; flotation of ores; dental cements; chemistry of laundering; natural gas; refractories; byproduct coking; fiber containers; heat insulation; glue; insecticides; food and beverage flavors; inks; protected metals; sulphur, and galvanizing.

During the past year the Institute has contributed to science and technology two books, forty research reports and thirty-one other scientific papers and has issued thirty-five United States patents.

Department of Commerce and Engineering Societies Co-operate on Standardization

At the request of Secretary of Commerce Hoover, the American Engineering Standards Committee will undertake at once a canvass to determine what simplification in manufactured products is most needed and most desirable. This canvass will be conducted through the engineering and technical bodies having representatives on the committee or co-operating in its work. The survey of simplification or standardization needs and possibilities will extend into almost every industry in America.

This assignment to the American Engineering Standards Committee is one of Mr. Hoover's steps to retrieve for American industry part of the waste which was pointed out by the well-known report on waste in industry which was made by a committee also appointed by Mr. Hoover while he was chairman of the Federated American Engineering Societies. The latter committee found that waste in industry was due largely to an overmultiplicity in number of products as well as to inefficiency in processes.

There has been considerable discussion as to what should be the relationship between the simplification work of the Department of Commerce and the standardization work of the American Engineering Standards Committee. An arrangement has been made for permanent exchange of representatives between the two organizations so that there may be the closest possible co-operation between the Commerce Department's division of simplified practice and the American Engineering Standards Committee, and duplication or overlapping will be avoided.

Former Alien Property Custodian Would Welcome Investigations of Activities During War

During the debate in the House on war frauds, Representative Garrett of Tennessee read a letter from former Attorney-General Palmer, expressing the hope that Congress would appoint a committee to investigate all contracts and expenditures made by the War and Navy Departments and the Alien Property Custodian. Mr. Palmer said charges and insinuations now being made with respect to the Chemical Foundation and the Bosch Magneto case have been repeated many times, although they were investigated by two Senate committees, but that until final disposition of German property is made by the Alien Property Custodian and Congress it was expected that these charges would be constantly reiterated. He stated that the Bosch Magneto Co. was German to the core and that before the United States entered the war its management violated our neutrality in a most flagrant fashion. He explains that sale of the company by the Alien Property Custodian was approved after careful investigation as to the adequacy of price and character of purchasers.

DEFENDS CHEMICAL FOUNDATION

Mr. Palmer pointed out that the Chemical Foundation is a non-profit corporation, formed to take over nearly 5,000 American patents owned by Germans in the chemical industry, which had been originally taken out by Germans to make it impossible for the chemical industry to develop in this country.

"Today by reason of the Alien Property Custodian's plan of Americanizing these German patents and distributing them to the American producers through a semi-public institution like the Chemical Foundation, having for its purpose only the development of the chemical science in America, it has become apparent that the world can never again be caught in the clutches of a German control of the chemical industry," said Mr. Palmer. "I have no hesitation in saying that the biggest achievement of the Alien Property Custodian for the benefit of our country and its future welfare and security was the formation of the Chemical Foundation and the sale of these German patents to it. The Germans recognize its transcendent importance and would now resort to any device to set aside that sale and have the patents restored finally to their German owners in the hope that they could thus again dominate the chemical industry of the world. Their present plan seems to be to discredit the Alien Property Custodian and thus persuade the government of the United States, either through Congress or the executive departments, to take such action as will restore to Germany the stranglehold upon American industry and commerce in many important lines of industry which the Alien Property Custodian loosened as a part of the government's policy in prosecuting the war."

Bureau of Mines Investigates Sands Used in Aluminum-Alloy Foundry Practice

The Bureau of Mines, as one of the governmental agencies directly co-operating in a general research of all foundry sands organized by the American Foundrymen's Association and the National Research Council, is collecting data on sands for molds and cores in aluminum-alloy foundry practice.

There is pressing need of collated information on sands used in aluminum-alloy founding, and it is hoped, as a result of the investigation, to aid in disseminating knowledge on the subject. A questionnaire is being sent by the Bureau of Mines to aluminum-alloy foundries in the United States in order to obtain data to be used in the preparation of a report. It is possible that some foundries of this kind are not upon the bureau's mailing list, and it is hoped that any such plants that do not receive the questionnaire will apply for one. While the replies to the questionnaire will be summarized for publication, the contents of individual communications will be held strictly confidential. Communications in regard to the matter should be addressed to R. J. Anderson, metallurgist, U. S. Bureau of Mines Experiment Station, Pittsburgh, Pa.

International Congress on Liquid Fuels to Be Held in Paris in October

An international congress for the discussion of general problems in the rapidly growing field of liquid fuels is being arranged by the Société de Chimie Industrielle. The meeting will be held in Paris during October, 1922. Prof. Paul Sabatier will preside over the sessions, which will be devoted to discussions on two main topics—namely, terminology for liquid fuels and methods of analysis. The organizers of the congress have asked a number of specialists in the liquid fuel industries for suggestions as to the detailed points to be discussed. All the suggestions are to be grouped into six sections as follows: Petroleum, shale oil, lignite and peat, tar and benzene, alcohol and vegetable oils.

The honorary committee of the organization consists of Prof. Paul Sabatier, of Toulouse, president, Profs. D. Bertholet, le Chatelier, Lindet and Moureau. The active committee is composed of Profs. d'Arsonval, Baumé, Brylinski, Charpy, Duchemin, Demarais, Gerard, Mailhe, Matignon and Willems. The committee feels that the present interest in liquid fuels in America will warrant the attendance of numerous Americans and extends a cordial invitation to those interested. A liquid fuels exposition will be held in Paris during the entire month of October in connection with the congress, the exact date of which has not been definitely announced.

Enamel Division, American Ceramic Society, Plans Research on Enameled Cast Iron

The Enamel Division of the American Ceramic Society is undertaking an investigation of cast iron for enameling purposes. At a recent meeting of the committee delegated with this research, a comprehensive program was drawn up, particular attention being paid to the blistering of enamels applied to cast iron. This investigation will be conducted in co-operation with the enameled metal section of the Bureau of Standards and it is hoped to actively interest all cast iron enamellers of the division.

The research sub-committee on sheet iron and steel has planned an investigation of the warpage and buckling of iron and steel sheets in the enameling process. It is planned to conduct the preliminary studies at the Bureau of Standards and to follow this by co operative work in several of the enameling plants engaged in the enameling of flat sheets.

The bylaws of the division have been revised to conform with revisions in the rules of the society.

International Union of Pure and Applied Chemistry Announces Topics for Discussion at Lyon

Announcement is made of the principal subjects to be discussed by the congress of the International Union of Pure and Applied Chemistry which is to meet in Lyon, France, June 27 to July 2. Among the topics to be considered are the following: Chemical elements, reform of nomenclature, bibliographic abbreviations, unification of chemical abstracts, international institute of chemical standards, thermochemical standards, tables of constants, international laboratory for food products, national and international laboratories for ceramics and for combustibles, international patents, industrial hygiene in the chemical industry.

Several points will be laid before the congress for further study, among which are: Signs of potentials of electrodes, international definition of the term ceramics, conservation of foods by physical and chemical processes.

Helium Appropriation Reduced

The recommendation of the Military Affairs Committee on the helium provisions of the War Department appropriation bill was adopted by the Senate. The committee recommended the reduction of the appropriation for experimental work on helium from \$400,000 to \$300,000, as proposed by the House. In spite of opposition from Senator Sheppard of Texas, the Senate adopted the recommendation.

American Electrochemical Society Officers Appointed—Symposiums Planned for Spring Meeting

At a recent meeting of the board of directors of the American Electrochemical Society, Dr. J. A. Mathews was appointed to fill the unexpired term of C. G. Schluederberg as vice-president and George K. Elliott was appointed to fill the unexpired term of C. G. Fink as manager. F. A. J. FitzGerald was reappointed chairman of the publication committee and H. A. Hinckley was appointed chairman of the membership committee.

William G. Horsch of the Massachusetts Institute of Technology was appointed chairman of a committee to arrange a symposium for the spring, 1923, meeting on the subject of Electrode Potential. Members of the society and others desiring to participate in this symposium are requested to communicate with Professor Horsch. The symposium will cover the following studies: Reversible electromotive force, overvoltage, ion activities and dissociation, electro-titration and pH determinations.

The Electrothermic Division has prepared a symposium on industrial heating for the fall meeting at Montreal, Sept. 21 to 23.

British Parliament Moves to Protect Trade Marks

An important bill amending the present merchandise marks act, which prescribes the requirements for the marking of goods imported into the United Kingdom, has been submitted to the British Parliament.

Part 1 of this measure relates to merchandise marks and provides that an order may be made requiring an indication of origin if the Board of Trade is of opinion that a false impression as to the origin of any class of imported goods is likely to arise. Section 2 of part 1 authorizes the Board of Trade to prohibit the application to imported goods of any national or other public device reasonably calculated to lead any person to believe that the goods are of British origin. Section 4 prohibits the importation into the United Kingdom of goods to which there is applied a forged trade mark or false trade description, or to which a trade mark is falsely applied within the meaning of the act and of any goods to, or in connection with which, a national or other public device is applied in contravention of the provisions of an order under the act, unless the device is accompanied by an indication of origin.

Gas and Fuel Section New Feature of Next American Chemical Society Meeting

A gas and fuel section of the American Chemical Society has been authorized for the next meeting, which is to be held in Pittsburgh the first week in September. Among other subjects discussed will be the general topic: "Combustion." This special symposium will be under the chairmanship of Prof. R. T. Haslem of Massachusetts Institute of Technology. It will include a program of papers on chemical methods underlying fuel utilization.

Officers of the new section are: Chairman, Dr. A. C. Fieldner, Bureau of Mines, Pittsburgh, and secretary, R. S. McBride, Colorado Building, Washington. Any members of the society having papers to present at the meetings of this section should forward them in full or in abstract form to the chairman or secretary or should notify these officers regarding their intention to prepare the paper later.

Safety Institute Starts Film Service

The Safety Institute of America has inaugurated a safety film service for members and others particularly interested, it is announced at the headquarters of the Institute, 141 East 29th St., New York City. This service was made possible by an initial gift from the department of safety, sanitation and welfare of the United States Steel Corporation. The Safety Institute will endeavor to build up its collection of moving pictures to the proportions of its stereopticon safety slide collection, which is now probably the largest in existence.

Explosion in Synthetic Ammonia Plant of Atmospheric Nitrogen Corporation

Four persons were injured in an explosion on June 11 at the new Haber process plant of the Atmospheric Nitrogen Corporation at Solvay, just west of Syracuse, N. Y. Officials of the Allied Dye and Chemical Corporation, of which the Atmospheric-Nitrogen Corporation is a subsidiary, were not able to explain the cause of the accident or to estimate the damage. It was stated, however, that operation will be normal within a few days. The damage was confined to the interior of the process building, the walls remaining intact.

Tungsten, Molybdenum and Vanadium Discussed at New York Section, A.C.S., Meeting

Tungsten, molybdenum and vanadium, metals which are immediately associated with high-speed tool steels, were discussed from a different angle at the New York Section of the American Chemical Society on June 9. C. W. Balke, of the Fansteel Products Co., and B. D. Saklatwalla, of the Vanadium Corporation of America, presented papers dealing with the preparation of these metals in a pure state and their applications other than in the special steels.

One of the most interesting points brought out by Dr. Balke was his mention of the work that is in progress on the metal tantalum. He showed samples of tantalum powder, rods and plates and predicted that this unusual metal will find unique uses in the chemical and other industries, due to its remarkable resistant properties. It was stated that tantalum is absolutely unaffected by boiling aqua regia or any other acid except hydrofluoric. This property makes it ideal for the manufacture of dental instruments. It absorbs gases with avidity, taking up 750 times its own volume of hydrogen. This property is desirable in wireless bulbs where high vacuum is essential.

The preparation of pure tungsten and molybdenum is very similar, the only differences in the process being due to the lower melting point of molybdenum.¹ Tungsten melts at 3,350 deg. C., the highest melting point of any known metal while molybdenum melts at 2,500 deg. C. The extremely high fusing temperature of tungsten makes it unique among the metals in that it is never melted in the course of its preparation and exhibits properties at room temperature which correspond to those of ordinary metals at very low temperatures. At higher temperatures tungsten has the highest tensile strength and the lowest coefficient of expansion of any known metal.

The metal is prepared from wolframite, an iron, manganese tungstate, by fusion with soda ash in a reverberatory furnace and the formation of soluble sodium tungstate. This is leached from the fusion mass and converted to the oxide. The physical and chemical properties of the oxide have a decided effect on the grain size of the metallic tungsten prepared from it. A fine fluffy oxide yields a fine metallic powder, while a dense oxide yields a coarser powder. The oxide is reduced in an electrically heated quartz tube in an atmosphere of hydrogen. About 9 cu.ft. per minute of hydrogen is passed over each charge of 2 kg. The metallic tungsten powder is compressed into an ingot at a pressure of 50 tons per sq.in. The bar is then placed in a sintering furnace and heated by electric resistance almost to its melting point in an atmosphere of hydrogen. The sintering operation causes the crystallization of the metal. The bars are then heated and swaged or hammered at a temperature of about 1,500 deg. C., during which process the crystals become elongated. Finally, the swaged rods may be drawn into wire.

An interesting point was brought out by Dr. Balke's mention of the function of thoria in tungsten for lamp filaments. The thoria fuses, forming minute globules between the tungsten grains, thus retarding their growth. When the tungsten is drawn into wire, the thoria globules are drawn into little rods which prevent the crystallization and breaking of the filament.²

¹See Jones, CHEM. & MET. ENG., vol. 22, p. 15 (Jan. 7, 1920).

²See Jeffries and Archer, CHEM. & MET. ENG., vol. 26, p. 406 (March 1, 1922.)

Dr. Balke stated that ten times as much pure tungsten is used for contact points for electrical equipment as for lamp filaments. He showed a large number of slides including photographs of the plant and apparatus and photomicrographs of the grain structure of numerous samples.

The freakish properties of vanadium, the history of its development and the modern process of extracting it from its ores were described by B. D. Saklatwalla. The element remained a laboratory curiosity for over a hundred years because no commercial deposits had been found. Studies of its effect in steel in 1900 may be said to mark the beginning of its commercial importance. Several processes of extracting the metal from its ores were described, the roasting and dry smelting process and the aluminum thermic reduction. The ordinary smelting processes are inefficient, because the oxides of vanadium are extremely refractory and combine with the flux and are lost. The Goldschmidt process overcomes this difficulty as it accomplishes instantaneous reduction by intense local heating. It is necessary however, to fix a very definite balance of ingredients in order to form the proper slag and to liberate the right amount of heat. The electric furnace method which is now being used duplicates this effect. The charge is fed continuously into the small space between the electrodes. A very high current density is used and the result is instantaneous reduction by the intense local heat.

Short Courses in Practical Paper Making Offered This Summer by University of Maine

During the period of six weeks beginning June 26 the chemistry department of the University of Maine will again conduct a summer school course in pulp and paper chemistry and technology. The University of Maine was the first institution to offer such a course in America and now has over ten years' experience in determining the nature of the courses offered and the content of each. In Maine today there is more capital invested in pulp and paper mills than in any other industry, and this fact alone means ever increasing co-operation between the pulp and paper courses of the university and the mills. Within a short distance of Orono are to be found pulp and paper mills of all kinds, soda, sulphite, sulphate and mechanical pulp mills, newsprint, bag, wrapping, tissue, novelty and writing paper mills.

Among the courses offered are the following: Paper testing and analysis; pulp manufacture, soda and sulphite processes; pulp bleaching and general, organic and physical chemistry.

The university library with its large collection of foreign and domestic pulp and paper journals, books and theses will be open daily. The paper and chemical work will be carried on in Aubert Hall under the same conditions as apply during the regular session.

Paint Works on Antimony Field in Australia

A new company has acquired the interests of the antimony and gold mines near Heathcote, Victoria, and intends to use the antimony sulphides for the manufacture of a metallic, non-poisonous paint. New works will be erected at a cost of £20,000, states the *Industrial Australian*, for the manufacture of paint and the production of refined antimony. Hitherto the antimony has been shipped to Yorkshire for treatment. The output is about 300 tons a month. The lodes have been proved to carry good values to a depth of over 900 ft.

Water Pollution Resolution Passes House

The Appleby resolution on pollution of navigable waters has been passed by the House. The resolution requests the President to call a conference of maritime nations with a view of adopting means to prevent the pollution of navigable waters by oil-burning and oil-carrying vessels. Representative Stafford, of Wisconsin, sought to have the resolution apply to the Great Lakes, but it was decided that this matter should be considered in a separate resolution.

Pan-Pacific Conference to Foster International Relations

The fourth conference called by the Pan-Pacific Union, of which Wallace R. Farrington, Governor of Hawaii, is president, will meet in Honolulu, Oct. 25, 1922. This is the fourth in the series of conferences which the Pan-Pacific Union is calling. The first was a conference of scientists from about the Pacific; the second, of educators; and the third, of journalists. The most valuable result coming from these gatherings of the leaders of the Pacific is the forming of interracial friendships—friendships which may have a vital influence in developing and preserving cordial relations among the nations themselves.

The conference will cover a period of 2 weeks, one of which will be devoted to sightseeing and entertainment features through Hawaii and Hilo. The business sessions will include discussions on communication, transportation, development of natural resources, finance and investments and international relations in the Pan-Pacific area. One day will be devoted to a discussion of significant Pan-Pacific commercial problems, one speaker from each country represented having been chosen to present the problems of his own country.

Bureau of Chemistry Book on Dust Explosions

"Dust Explosions," a book containing the results of 7 years of investigation by the United States Department of Agriculture, is soon to be issued by the National Fire Protection Association, Boston, Mass., in the interest of reducing fire and explosion losses. The book was prepared by David J. Price and Harold H. Brown of the Bureau of Chemistry of the department, and is expected to be a welcome addition to the meager literature on a subject that has been found of great economic importance to divers industries.

Chapters are devoted to nature and theory of dust explosions, industries producing dust and their extent, elimination of sources of ignition, prevention of explosions by control of explosive mixtures, phenomena of explosions, dust collection and removal, static electricity, explosions in grain-threshing machines, plant construction, cotton gin fires, coal dust explosions, and review of explosions.

Cotton Manufacturers' Association Indorses Dye Embargo

Continuance of the "qualified embargo on foreign dyes" was indorsed and approved by the American Cotton Manufacturers' Association in a resolution adopted at its twenty-sixth annual convention held in Washington. The resolution recommends to Congress passage of the provisions of the regular tariff bill providing for protection of the American dye and organic chemical industry.

Without protection, the resolution said, the "American dye industry would be crushed out and destroyed by the disastrous competition that would ensue." It is pointed out that all possibility of establishing an independent American dye industry will be lost for all time to come if the present development is destroyed.

Personal

FRANK W. DAVIS, who has been a metallurgist for a large part of the past 9 years with the Alan Wood Iron & Steel Co., is to be ferrous metallurgist of the Bureau of Mines. Mr. Davis will begin work on July 1 with headquarters at the Minneapolis station of the bureau. Under the direction of D. A. Lyon, chief metallurgist, he will be immediately responsible for co-ordination of the ferrous metallurgy research of the bureau.

T. H. EDWARDS, superintendent of the steel department at the Benwood, W. Va., plant of the Wheeling Steel & Iron Co., has resigned, following a service of 50 years in the industry. He will take up a residence at Denver, Colo.

DR. COLIN G. FINK has been appointed lecturer in electrochemistry and will have charge of that division of the department of chemical engineering, Columbia University, beginning July 1. He will continue his services as secretary of the American Electrochemical Society, office facilities having been arranged at Columbia for this.

F. S. HARVEY, engineer for the American Sugar Refining Co., gave an interesting address before a recent meeting of the Engineers' Club, Baltimore, Md., on the subject of the new local refinery of the company.

HARLAND M. JOSEPH, Midway, Del., has been appointed manager of the Lewes Fertilizer Co., Lewes, Del., succeeding William C. Lofland, deceased.

J. A. LECLERC has resigned from his position as chief chemist of the Miner-Hillard Milling Co., Williamsport, Pa. He is continuing his work on the problems of export of corn products, to which subject he has devoted himself for the past several months, largely working under the Bureau of Foreign and Domestic Commerce, for which he made a trip to Europe recently. Further effort in this field will be directed toward co-ordination among those who are interested in export of degerminated corn products, for which large foreign markets are expected.

PAUL LEONI, president of the Iron & Ore Corporation, 11 Broadway, New York, recently sailed for Europe on a business trip.

DORSEY A. LYON, chief metallurgist of the Bureau of Mines, had conferred upon him the degree of Doctor of Science by the University of Utah, in recognition of his services in developing metal research in this country.

WILLIAM J. MERTEN, metallurgical engineer of the Westinghouse Electric & Manufacturing Co., has been elected vice-chairman of the Pittsburgh chapter of the American Society for Steel Treating.

T. A. MITCHELL, consulting chemical engineer of Rogers, Brown & Co. of New York, returned May 22 from a trip to England, France and Belgium.

DR. CHARLES L. PARSONS, secretary of the American Chemical Society, sailed from New York June 13 to attend the conference of the International Union of Pure and Applied Chemistry, which will be held at Lyons, France, June 27 to July 2. Dr. Parsons also will attend the meeting at Marseilles of the society of French industrial chemists. He will address that gathering on "The Application of Chemical Research in Industry in America." Dr. Parsons is vice-president for America of the International Union of Pure and Applied Chemistry. Other delegates to the Lyons conference are: E. W. Washburn, H. S. Washington, Edward Bartow, Edward S. Chapin and R. B. Moore. Dr. Atherton Seidell, of the U. S. Public Health Service, also will attend the Lyons conference.

DAVID J. PRICE, chief of the dust explosions investigations of the Bureau of Chemistry, spoke before the Millers' National Federation convention in Kansas City on June 1. His address, entitled "Progress Made by Flour Milling Industry in Dust Explosion Prevention," related not only to the problems of prevention of explosions in cereal industries, but also to the general problem of preventing the hazards attendant upon the presence of industrial dusts. Special mention was made of several recent explosions where sulphur powder used in making lime sulphur insecticide had caused disastrous explosions.

Obituary

MICHAEL E. CLAFFEY, superintendent of the Monroe-Taylor Chemical Co., died at his home, 14 Stephens Court, Brooklyn, N. Y., May 27, aged 85 years.

H. T. OXNARD, for the past 10 years vice-president of the American Beet Sugar Co. and prior to that time president of the company, died at the University Club, New York, June 8, of heart disease. He was 62 years of age and resided at Upperville, Va.

Market Conditions

IN CHEMICAL, METALLURGICAL AND ALLIED INDUSTRIES

A Survey of the Economic and Commercial Factors That Influence Trade in Chemicals and Related Commodities—Prevailing Prices and Market Letters From Principal Industrial Centers

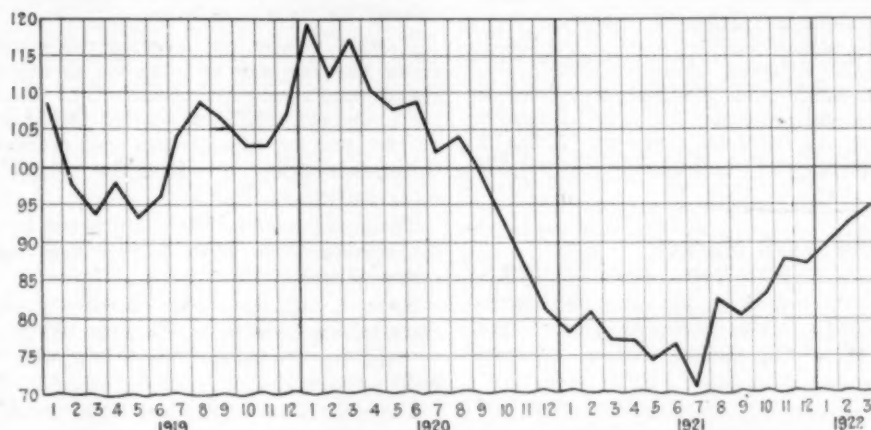
The Increasing Volume of Manufacture

Some time ago the Harvard Economic Service constructed an adjusted volume index to follow the trend of production in the United States. In this index an attempt was made to eliminate both long-time and seasonal variations. In other words, the Committee on Economy Research sought to evaluate (1) the seasonal influences to which practically every industry is subject and (2) the long-time movement resulting from increasing population and industrial development.

As is evident from the accompanying chart, this index number is gradually approaching its normal value of 100, having risen from a low of 75 last July. In commenting on this improvement in the index in the weekly letter of May 27, the Harvard service makes the following significant statement: "The steady upward movement of production during the intervening months (July, 1921, to June, 1922) has afforded one of the most solid bases for optimism, since this increase in output has been in response to a

definite increase of demand. This stimulus is more and more manifest."

It is unfortunate that so few data are available on the volume of production in the chemical and allied industries. Current figures for a limited number of these commodities are normally compiled by certain governmental agencies and by the trade associations within these industries. On the whole, however, chemical production statistics are practically non-existent. The May number of the *Survey of Current Business* for the first time includes data on the monthly output of two important wood chemicals—acetate of lime and methanol, or wood alcohol. These figures show a very interesting trend, but it would of course be hazardous to intimate that they are indicative of production in all lines of chemical manufacture. The percentage comparisons with the preceding year are most striking. During the first quarter of 1922 there was produced 27,570,000 lb. of calcium acetate—a 50.6 per cent increase over production in the same period of 1921. The output of methanol during this period



THE HARVARD ECONOMIC SERVICE ADJUSTED INDEX OF THE VOLUME OF MANUFACTURE
(Normal = 100)

TABLE I—THE TREND OF PRODUCTION IN CERTAIN OF THE CHEMICAL AND RELATED INDUSTRIES

Production of—	Feb., 1922	Mar., 1922	First 3 Months of 1921	First 3 Months of 1922	Percentage Increase or Decrease in 1922
Acetate of lime, thous. of lb.	7,942	11,134	18,309	27,570	+50.6
Alcohol (wood), gal.	433,024	587,928	1,262,760	1,473,652	+16.7
Cement, thous. of bbl.	4,278	6,685	15,240	15,254	+0.1
Coke, byproduct, thous. of short tons	1,795	2,137	5,938	5,835	-1.7
Coke, beehive, thous. of short tons	549	732	2,577	1,777	-31.0
Cottonseed oil, thous. of lb.	91,321	72,237	483,222	264,264	-45.3
Leather, sole, thous. of sides	1,466	1,473	3,720	4,593	+23.5
Leather, finished upper, thous. of sq. ft.	70,296	77,510	118,827	222,369	+87.1
Linseed oil*, thous. of lb.	6,647	7,232	20,631	20,336	-1.4
Metals:					
Pig iron, thous. of long tons	1,630	2,035	5,949	5,303	-10.9
Steel ingots, thous. of long tons	2,072	2,816	6,560	6,781	+3.4
Copper, thous. of lb.	37,416	61,867	251,564	125,131	-50.3
Zinc, thous. of lb.	45,026	53,064	118,852	145,502	+22.4
Paper and pulp:					
Wood pulp, chemical, sh. tons	144,568	170,995	379,749	473,309	+24.6
Newsprint, sh. tons	97,786	117,507	334,402	321,101	-4.0
All other paper, sh. tons	404,031	475,353	934,809	1,280,771	+37.0
Petroleum:					
Crude oil, thous. of bbl.	40,814	46,916	114,230	130,871	+14.6
Gasoline, thous. of gal.	398,223		1,848,620	1,842,846	-0.7
Kerosene, thous. of gal.	167,220		1,368,457	1,340,137	-7.7
Rubber:					
Crude†, thous. of lb.	18,467	26,771	26,524	66,418	+150.4
Pneumatic tires, thous.	2,084	2,646	2,686	6,875	+152.6
Sugar:					
Imports, raw, long tons	448,321	571,836	753,606	1,335,096	+77.2
Meltings, raw, long tons	415,723	535,357	825,482	1,242,681	+50.5

* Shipments from Minneapolis.

† Includes January and February only.

‡ Consumption by tire manufacturers.

was 1,473,652 gal. as compared with 1,262,760 gal. in Jan.-Feb.-March, 1921. This is an increase of 16.7 per cent. In March, 1922, the production of methanol was 587,928 gal., while in the corresponding month in the preceding year it was but 403,838 gal.

Other production and consumption statistics of interest to the chemical industries are shown in Table I. These are from the "Trend of Business Movements" section of the Department of Commerce *Survey of Current Business*. It is to be hoped that the organization of a chemical commodity division in the Bureau of Foreign and Domestic Commerce will be followed by an intensive effort to compile and promptly present current production statistics on such basic chemical commodities as sulphuric and the other mineral acids, caustic soda and the alkalis, and ammonium sulphate and other fertilizer materials.

CHEMICAL & METALLURGICAL ENGINEERING'S WEIGHTED INDEX OF CHEMICAL PRICES

Base = 100 for the year July 1, 1913, to June 30, 1914

This week	157.93
Last week	158.12
June, 1917	222
June, 1918	272
June, 1920	274
June, 1921	147
April, 1918 (high)	286
April, 1921 (low)	140

This week's index number reflects the slightly lower prices for barium chloride and linseed oil. Higher prices noted in the case of benzene and copper sulphate were insufficient to offset the decline. Since May 24 this index number has fallen almost 3 points.

Davison Chemical Co. Reports Six-Million Dollar Surplus in 1921

The annual report of the Davison Chemical Co. and its subsidiaries, the Davison Sulphur & Phosphate Co. and the Silica Gel Corporation, is notable in that it is one of the few fertilizer manufacturing companies to have met the deflation of 1921 without seriously impairing its surplus. The profit and loss surplus at the end of 1921 stood at \$1,804,336, to which has been added \$4,425,709 as capital surplus value of ore blocked out, giving a total surplus of \$6,230,045. This compares with \$6,641,984 in 1920 and \$6,273,926 in 1919.

According to an analysis of the consolidated balance sheet which has been made by the *Wall Street Journal*, the company retired \$604,000 of Davison Sulphur & Phosphate bonds in 1921 at a cost of \$579,451. Prior to March 1, 1922, bonds of \$1,122,000 par value were converted into 18,700 shares of stock in the Davison Chemical Co., so that the only funded debt now is \$2,000,000 of 8 per cent gold debentures.

Investment in the Silica Gel Corporation (200,000 shares) is carried at \$24,795, while \$408,479 is due from the corporation in accounts receivable. Presumably this is the money advanced for experimental and research work and in constructing the experimental plant for oil refining. The total accounts receivable are \$860,262, compared with \$540,928 last year. Cash and inventories show little change from the previous report. Current liabilities are \$1,153,691, including \$703,331 notes and \$331,156 accounts, as against \$526,758 in notes and accounts last year. Reserves for depreciation amount to \$804,345, against \$799,919. Working capital is \$1,152,150, as against \$1,957,363 last year.

The New York Market

NEW YORK, June 12, 1922.

Trading so far during the month of June has been without significant developments. The chemical market has been colorless and except for the merest routine, business has been unusually quiet.

Consumers, it would appear, are showing no inclination to lay in large stocks and are buying in small lots—often in the spot and resale markets. Manufacturers, on the other hand, believe that the bottom of the market has been reached and therefore are inclined to wait for the enactment of pending tariff legislation in the hope that it will bolster up prices.

From the long-time viewpoint the dye people have reason to be encouraged, first by the higher scale of duties recently approved in the Senate and second by the resumption of activity on an increasing scale in the textile centers. Unfortunately, however, neither of these factors is having immediate effect and with the exception of higher prices asked by the producers for a few crudes, the coal-tar products market remains stagnant.

INDUSTRIAL CHEMICALS

Alums—The alum group is being quoted at somewhat lower prices notwithstanding reports of production difficulties. Imported potash alum is quoted at \$3.75@4 per 100 lb., but in some quarters prices as low as \$3.10 were heard. Chrome alum is being handled at 5½@6c., as compared with a price of 7c. a few weeks ago. Ammonia alum is unchanged at 3¼@3½c. for sizable orders.

Ammonium Sulphate—The market for this and most other fertilizer materials has been without change, although announcement of next season's price is expected soon. It is rumored that on ammonium sulphate the new price will be in the neighborhood of \$3 per 100 lb. At present trading is at \$3.25@3.40 per 100 lb. in double bags f.a.s. New York.

Arsenic—Importers report a fair inquiry for Japanese white arsenic. In carlots this is quoted at 6¼@7c. per lb.

Barium Chloride—Trading in this article has eased up a bit of late and the tendency is toward lower prices. Imported material for June arrival is being offered at \$88@

\$90. Spot supplies are held at \$97@100, the latter being the price asked by the domestic producers.

Caustic Potash—The market remains unchanged at \$5.75@6 for sizable orders and shipment material is held at slightly lower prices.

Caustic Soda—Inquiries from abroad are being received in fair volume, according to the exporters, and the 76 per cent in drums is quoted at \$3.85 f.a.s. The domestic prices are \$3.75@4 for contracts, carlots, ex-works. The ground and flake caustic can be bought in drums at the producer's plant for 3¼@3½c. per lb.

Copper Sulphate—The scarcity of blue vitriol is as yet unrelieved and spot material is difficult to purchase under 6c. per lb.

Oxalic Acid—Although business in oxalic is slow, the recent high prices still prevail, principally because this material is scarce in the New York market.

Prussiate of Potash—Red prussiate of potash is back in the market again this week, but supplies are comparatively small. The yellow salt is in somewhat better supply, but prices are showing an upward tendency. Red prussiate is quoted at 80@85c. and the yellow at 32@33c.

Prussiate of Soda—The market is at a standstill and goods on hand are moving at 21½@22c., with lower prices offered for future delivery.

Shellac—Slight advances in price have been applied all along the line due both to the strengthening sterling exchange and recent information that foreign supplies are not too abundant. T. N. is quoted for shipment, June arrival, at 78c., but the price in the spot market has been 80@82c. Orange superfine is selling for 84@86c. per lb. and the A. C. garnet at 66@68c.

Sodium Nitrate—Crude saltpeter is somewhat lower in the spot market, with \$2.50@2.75 covering the general range of quotations.

Sodium Silicate—New contract prices for the 40 deg. material are said to be 75c. per 100 lb. in tank cars, f.o.b. works, 80c. in drums for carlots and less than carlots at \$1.05.

Tartaric Acid—The market for tartaric acid is somewhat firmer and during the week advances of ¼@1c. were reported. Imported crystals now sell for 28½@29c. and the powdered at 29½@30c.

VEGETABLE OILS

Cottonseed Oil—There have been few developments in the local oil market during the past week. Cottonseed oil exports have fallen to practically nothing. Crude oil was not offered in any quantity and what transactions took place were at 10c. per lb., buyers' tanks, f.o.b. mills.

Linseed Oil—The market for linseed oil has been comparatively quiet, with a tendency toward lower prices. Domestic crushers maintained 82@84c. per gal., but quotations as low as 80c. were heard during the week. The imported oil for June shipment was quoted at 78@80c.

The St. Louis Market

ST. LOUIS, June 8, 1922.

The St. Louis market for industrial chemicals was somewhat stagnant last week, due in all probability to the holiday intervening. There is more activity this week, however, and prices in general are very firm. In fact there is more stability to the market today than there has been for many months past. Domestic manufacturers do not feel the effects of imported material as severely as they did some time ago, although at times the foreign material still upsets the market temporarily. The volume of business transacted during the month of May was very appreciable with favorable indications for continuance.

ALKALIS

Contrary to our prediction in the May 23 report, caustic soda did not advance, but has remained the same or been shaded slightly in one or two instances. The soda ash mar-

ket has been very quiet recently, but prices have held up to former levels. *Sodium bicarbonate* is moving freely and maintaining a steady price. *Sal soda* is selling in good volume, but competition has caused some decline in recent prices.

GENERAL AND SPECIAL CHEMICALS

The *sulphuric, nitric and muriatic acid* group is moving very well and prices are somewhat firmer today. *Citric acid* remains in good demand, with limited stocks in some localities. The advance which was expected some time ago has not as yet materialized. There has been very good inquiry for *oxalic acid*, but we do not believe that the actual buying has been in proportion with the volume of inquiry. *White arsenic, powdered*, today is quoted at 7½c. per lb. f.o.b. St. Louis, with a strong market. *Carbon bisulphide* is moving quite freely and orders of large volume are being placed. Prices are firm. *Epsom salts* is in fair demand and being quoted at \$2.50@2.60 per 100 lb., f.o.b. St. Louis. *Glycerine* apparently has reached rock bottom. We had predicted a decline, but so far it has failed to materialize, and since quite a few contracts are renewed about this time a decline now is hardly to be expected. The demand for *potassium ferricyanide* is far in excess of available stocks. *Sodium cyanide* is in good demand, and with the imported material gradually disappearing, the demand for domestic goods is much better. *Sulphur* has not changed in price and the volume of business on this item continues heavy. *Zinc sulphate, technical*, is moving freely with a strong market at 3c. per pound, f.o.b. St. Louis.

VEGETABLE OILS AND NAVAL STORES

Linseed oil has suffered a slight decline since our last report and is now quoted at \$1.01, basis raw oil. *Turpentine* continues around \$1, with the usual daily up and down fluctuation. *Castor oil* shows no tendency to weaken and the price of 12½c. in 200-gal. lots seems to be absolutely rock bottom.

PAINT MATERIALS

The paint grinders in this locality are kept very busy and the result is plainly evident in their purchases. So far no dealer has developed sufficient courage to advance prices, so we have no changes to report.

The Iron and Steel Market

PITTSBURGH, June 9, 1922.

The monthly report of the American Iron and Steel Institute, giving the steel ingot production of the thirty steel companies that make monthly returns, indicates that the industry as a whole produced steel ingots in May at the rate of about 38,250,000 tons per annum, against a rate of about 36,600,000 tons in April. The rate at the end of March, when the coal strike began, was about 35,000,000 tons. The rate at present is probably a trifle above the average rate during May. Thus there has been an increase of something like 10 per cent in steel production since the coal strike started, following an increase of about 75 per cent in the 3 months preceding.

THE COAL STRIKE AND ITS EFFECTS ON STEEL PRODUCTION

The steel market is still a strong one and this fact, taken in connection with the increased production of steel in the first 2 months of the coal strike, makes it difficult to follow the theory that the strength of the steel market in the past few months has been due chiefly to the coal strike because the strike made buyers of steel anxious to pile up stocks against a possible interruption in shipments. Had buyers been actuated chiefly by such a motive, they would by this time be in such position as to be forced to begin liquidating the stocks thus accumulated.

That the coal strike has had a favorable influence upon the steel market in the matter of tonnage demand and in the prices obtainable for steel cannot be denied, but it cannot be maintained that the coal strike has been the chief factor.

On the other hand, it cannot be denied that the movement begun in the steel market will not last forever. The

longest movement, outside of the war period, lasted 3 years, from late in 1904 to late in 1907. The shortest movement lasted more than a year, from the time buying became fairly active to the time mills had to begin curtailing production on account of orders running short. The present is a regular movement, not a little burst of activity due to the incident of the coal strike. Those who have the least respect for the movement expect it to run well through autumn.

On April 1, when the coal strike started, steel production was at about two-thirds of capacity. It looked then as if the idle third was taken out by the coal strike, the analysis on this basis being that the steel market was as strong with a two-thirds operation as it used to be with a full operation. Now the operation is nearly if not quite three-fourths and it would be quite rash to assume that the ending of the coal strike would make the other one-fourth effective. Labor shortages began appearing at a few points several weeks ago, and transportation shortage would probably prevent a 100 per cent operation of the steel industry, apart from other considerations. There is nothing weird about such suppositions. It is true that before the war the steel industry was always able to operate at its capacity when it had the necessary orders, except during the winter of 1902-3, when the first transportation breakdown in the history of American railroading occurred, but the situation today seems to be that the steel industry, with an actual capacity in ingots of 50,000,000 or 55,000,000 tons, is too big for the rest of the country.

STEEL PRICES

Steel prices are very firm all along the line, and in several products the minimum prices are made only by the Steel Corporation subsidiaries and then only to regular customers for delivery at mill convenience, other inquiries being turned down, whereupon the business goes to independents at higher prices. Along this line bars, shapes and plates are quotable at 1.60@1.80c., depending on the buyer, the tonnage, the specifications and the time of delivery.

A feature of the market situation is that steel is steel. The bottle neck is ingots. It is a detail what the steel is finished into, there being plenty of finishing capacity. Bars, shapes and plates are therefore on a level with each other. Likewise billets, small billets and sheet bars are all equally quotable at \$35 Pittsburgh or Youngstown. Sales of sheet bars at \$35 are now being made for July delivery.

PLATES, SHEETS AND STEEL PRODUCTS

The American Sheet & Tin Plate Co. has opened its order books for tin plate for second half delivery to manufacturing consumers and third quarter to jobbers, these being the usual periods. The price remains at \$4.75. Some of the independents had been talking of an advance to \$5, but \$4.75 is considered high enough. In sheets the company opened its books for July only, this being an innovation. Likewise the prices are unchanged, at 2.40c. for blue annealed, 3.15c. for black, 4.15c. for galvanized and 4.50c. for automobile sheets. Most independents, who had sold more or less for July at old prices, are now asking \$2 a ton more for blue annealed, \$3 more for black and galvanized, and \$5 more for automobile sheets.

Hoops, bands and hot-rolled strips are now commonly quoted at 2.40c., but the old price of 2.25c. can perhaps be done with the Steel Corporation by some regular customers. Cold-rolled strips have been advanced by independents to 4c., the American Steel & Wire Co. remaining at 3.75c. The wire company remains at \$2.40 on nails and independents have been forced to recede from their \$2.50 price, made about the middle of April, in the case of the most attractive orders.

The steel industry seems fortified to continue its present rate of production almost indefinitely despite the coal strike, which shows no material change.

The local pig iron market remains stagnant, the quotable level, largely nominal, remaining at \$25 valley for bessemer and basic and \$24 for foundry.

General Chemicals

CURRENT WHOLESALE PRICES IN NEW YORK MARKET

	Carlots F.o.b. N.Y.	Less Carlots F.o.b. N.Y.
Acetic anhydride.....lb.		\$0.38 - \$0.40
Acetone.....lb.	\$0.08 - \$0.09	09 - 10
Acid, acetic, 28 per cent.....100 lbs.	2.25 - 2.50	2.55 - 3.00
Acetic, 56 per cent.....100 lbs.	5.00 - 5.25	5.30 - 5.50
Acetic, glacial, 99 1/2 per cent, carboys.....100 lbs.	8.50 - 9.00	5.00 - 9.75
Boric, crystals.....lb.	11 - 11 1/2	11 - 12
Boric, powder.....lb.	11 - 11 1/2	11 - 12 1/2
Citric.....lb.		45 - 46
Hydrochloric.....100 lb.	1.10 - 1.20	1.25 - 1.70
Hydrofluoric, 52 per cent.....lb.	11 - 11 1/2	11 - 12
Lactic, 44 per cent tech.....lb.	09 - 10	10 - 12
Lactic, 22 per cent tech.....lb.	04 - 04 1/2	04 - 05
Molybdic, a.p.....lb.	3.00 - 3.25	3.30 - 3.75
Nitric, 20 deg. (see hydrochloric).....lb.		06 - 07
Nitric, 40 deg.....lb.	06 - 06 1/2	07 - 07 1/2
Nitric, 42 deg.....lb.	06 - 06 1/2	07 - 07 1/2
Oxalic, crystals.....lb.	14 - 14 1/2	14 - 15
Phosphoric, 50 per cent solution.....lb.	08 - 08 1/2	08 - 09 1/2
Picric.....lb.	22 - 24	24 - 30
Pyrogallol, resublimed.....lb.		1.65 - 1.75
Sulphuric, 60 deg., tank cars.....ton	10.00 - 11.00	
Sulphuric, 60 deg., drums.....ton	12.00 - 14.00	
Sulphuric, 66 deg., tank cars.....ton	15.00 - 16.00	
Sulphuric, 66 deg., drums.....ton	19.00 - 20.00	20.50 - 21.00
Sulphuric, 66 deg., carboys.....ton		
Sulphuric, fuming, 20 per cent (oleum) tank cars.....ton	19.50 - 20.00	
Sulphuric, fuming, 20 per cent (oleum) drums.....ton	22.00 - 22.50	23.00 - 24.00
Sulphuric, fuming, 20 per cent (oleum) carboys.....ton	31.00 - 32.00	33.00 - 34.00
Tannic, U. S. P.....lb.		60 - 75
Tannic (tech.).....lb.	40 - 45	46 - 50
Tartaric, imported crystals.....lb.		28 - 29
Tartaric acid, imported, powdered.....lb.		29 - 30
Tartaric acid, domestic.....lb.		30 - 31
Tungstic, per lb. of WO.....lb.		1.00 - 1.10
Alcohol, ethyl (Cologne spirit).....gal.		4.75 - 4.95
Alcohol, methyl (see methanol).....gal.		
Alcohol, denatured, 188 proof No. 1.....gal.		26 - 30
Alcohol, denatured, 188 proof No. 5.....gal.		26 - 30
Alum, ammonia, lump.....lb.	03 - 03 1/2	04 - 04 1/2
Alum, potash, lump.....lb.	03 - 04	04 - 05
Alum, chrome lump.....lb.	05 - 05 1/2	06 - 06 1/2
Aluminum sulphate, commercial.....100 lb.	1.50 - 1.65	1.70 - 2.25
Aluminum sulphate, iron free.....lb.	02 - 02 1/2	03 - 03 1/2
Aqua ammonia, 26 deg. drums (750 lb.).....lb.	06 - 07	07 - 08
Ammonia, anhydrous, cyl. (100-150 lb.).....lb.	30 - 30 1/2	30 - 31
Ammonium carbonate, powder.....lb.	07 - 07 1/2	07 - 08
Ammonium nitrate.....lb.	06 - 06 1/2	06 - 07 1/2
Amylacetate tech.....gal.		2.00 - 2.25
Arsenic, white, powdered.....lb.	06 - 07 1/2	07 - 08
Arsenic, red, powdered.....lb.	12 - 12 1/2	12 - 13
Barium carbonate.....lb.	03 - 04	04 - 05
Barium chloride.....ton	90.00 - 95.00	100.00 - 105.00
Barium dioxide (peroxide).....lb.	20 - 21	21 - 22
Barium nitrate.....lb.	06 - 07	07 - 08
Barium sulphate (precip.) (blanc fixe).....lb.	04 - 04 1/2	04 - 04 1/2
Blanc fixe, dry.....lb.	04 - 04 1/2	
Blanc fixe, pulp.....ton	45.00 - 55.00	
Bleaching powder.....100 lb.	1.70 - 1.85	1.90 - 2.75
Blue vitriol (see copper sulphate).....lb.	05 - 05 1/2	06 - 06 1/2
Borax.....lb.		28 - 35
Brimstone (see sulphur, roll).....lb.		
Bromine.....lb.	27 - 28	28 - 35
Calcium acetate.....100 lbs.	1.75 - 2.00	
Calcium carbide.....lb.	04 - 04 1/2	05 - 05 1/2
Calcium chloride, fused, lump.....ton	24.00 - 24.50	24.75 - 27.00
Calcium chloride, granulated.....lb.	01 - 01 1/2	02 - 02 1/2
Calcium peroxide.....lb.		1.40 - 1.50
Calcium phosphate, tribasic.....lb.		15 - 16
Camphor.....lb.		79 - 83
Carbon bisulphide.....lb.	06 - 06 1/2	07 - 07 1/2
Carbon tetrachloride, drums.....lb.	09 - 10	10 - 12
Carbonyl chloride (phosgene).....lb.		60 - 75
Caustic potash (see potassium hydroxide).....lb.		
Caustic soda (see sodium hydroxide).....lb.		
Chalk, precip.—domestic, light.....lb.	04 - 04 1/2	
Chalk, precip.—domestic, heavy.....lb.	03 - 03 1/2	
Chalk, precip.—imported, light.....lb.	04 - 05	
Chlorine, gas, liquid-cylinders (100 lb.).....lb.	05 - 05 1/2	05 - 06
Chloroform.....lb.		30 - 32
Cobalt oxide.....lb.		2.00 - 2.10
Copperas.....ton	20.00 - 22.00	23.00 - 30.00
Copper carbonate, green precipitate.....lb.	19 - 20	20 - 21
Copper cyanide.....lb.		58 - 60
Copper sulphate, crystals.....100 lb.	6.00 - 6.15	6.25 - 6.50
Cream of tartar.....lb.		24 - 25
Epsom salt (see magnesium sulphate).....gal.		60 - 65
Ethyl acetate com. 85%.....gal.		90 - 95
Ethyl acetate, pure (acetic ether, 98% to 100%).....gal.		09 - 09 1/2
Formaldehyde, 40 per cent.....lb.	08 - 08 1/2	
Fullers earth, f.o.b. mines.....net ton	16.00 - 17.00	
Fullers earth—imported powdered—net ton	30.00 - 32.00	
Fusel oil, ref.....gal.		2.25 - 2.65
Fusel oil, crude.....gal.		1.30 - 1.50
Glauber's salt (see sodium sulphate).....lb.		15 - 15 1/2
Glycerine, e. p. drums extra.....lb.		4.20 - 4.25
Iodine, resublimed.....lb.		12 - 18
Iron oxide, red.....lb.		09 - 12
Lead acetate.....lb.		14 - 15 1/2
Lead arsenate, powd.....lb.	14 - 14 1/2	15 - 20
Lead nitrate.....lb.		08 - 09
Litharge.....lb.	07 - 08	08 - 09
Magnesium carbonate, technical.....lb.	08 - 08 1/2	09 - 09 1/2
Magnesium sulphate, U. S. P.....100 lb.	2.50 - 2.60	2.65 - 2.85
Magnesium sulphate, technical.....100 lb.		1.00 - 1.80
Me innol, 95%.....gal.		57 - 58
Methanol, 97%.....gal.		59 - 60
Nickel salt, double.....lb.		11 - 11 1/2
Nickel salt, single.....lb.		10 - 10 1/2
Phosgene (see carbonyl chloride).....lb.		40 - 45
Phosphorus, red.....lb.		30 - 35
Phosphorus, yellow.....lb.		

	Carlots F.o.b. N.Y.	Less Carlots F.o.b. N.Y.
Potassium bichromate.....lb.	09 - 10	10 - 10 1/2
Potassium bromide, granular.....lb.		17 - 20 1/2
Potassium carbonate, U. S. P.....lb.	12 - 12 1/2	13 - 16
Potassium carbonate, 80-85%.....lb.	05 - 05 1/2	05 - 06
Potassium chlorate, powdered and crystals.....lb.	06 - 07	07 - 08
Potassium cyanide.....lb.		45 - 50
Potassium hydroxide (caustic potash).....100 lb.	5.75 - 6.00	6.25 - 6.50
Potassium iodide.....lb.		3.30 - 3.40
Potassium nitrate.....lb.	07 - 07 1/2	08 - 09
Potassium permanganate.....lb.	14 - 14 1/2	14 - 15 1/2
Potassium prussiate, red.....lb.		80 - 85
Potassium prussiate, yellow.....lb.	32 - 32 1/2	32 - 33
Rochelle salts (see sodium potas tartrate).....lb.		
Salammoniac, white, granular.....lb.	07 - 07 1/2	07 - 08
Salammoniac, gray, granular.....lb.	07 - 07 1/2	07 - 08 1/2
Salsoda.....100 lb.	1.20 - 1.40	1.45 - 1.60
Salt cake (bulk).....ton	20.00 - 25.00	
Soda ash, light, 58 per cent flat, bags, contract.....100 lb.	1.65 - 1.70	2.00 - 2.25
Soda ash, light, 58 per cent flat, bags, resale.....100 lb.	1.90 - 2.00	2.10 - 2.50
Soda ash, dense.....100 lb.	1.95 - 2.05	2.10 - 2.60
Sodium acetate.....lb.	05 - 05 1/2	05 - 06
Sodium bicarbonate.....100 lb.	1.80 - 1.90	1.95 - 2.40
Sodium bichromate.....lb.	07 - 07 1/2	07 - 08
Sodium bisulphate (nitre cake).....ton	4.50 - 4.60	4.65 - 5.50
Sodium bisulphate powdered, U. S. P.....lb.	04 - 04 1/2	04 - 05 1/2
Sodium chloride.....lb.	06 - 06 1/2	06 - 07
Sodium chloride, long ton.....12.00 - 13.00		
Sodium cyanide.....lb.	22 - 23	23 - 25
Sodium fluoride.....lb.	09 - 09 1/2	09 - 10
Sodium hydroxide (caustic soda) solid, 76 per cent flat, drums, contract.....100 lb.	3.35 - 3.50	3.80 - 4.00
Sodium hydroxide (caustic soda) solid, 76% flat, drums, resale.....100 lb.	3.85 - 3.90	3.95 - 4.25
Sodium hydroxide (caustic soda), ground and flake, contracts.....100 lb.	3.85 - 4.00	4.30 - 4.50
Sodium hydroxide (caustic soda) ground and flake, resale.....100 lb.	4.00 - 4.15	4.40 - 4.60
Sodium hyposulphite.....lb.	03 - 03 1/2	03 - 04
Sodium nitrate.....lb.	08 - 09	09 - 09 1/2
Sodium peroxide, powdered.....lb.	28 - 30	31 - 35
Sodium phosphate, dibasic.....lb.	03 - 04	04 - 04 1/2
Sodium potassium tartrate (Rochelle salts).....lb.		18 - 21
Sodium prussiate, yellow.....lb.	22 - 24	24 - 25
Sodium silicate, (40 deg. in drums).....100 lb.	85 - 1.00	1.05 - 1.25
Sodium silicate, (60 deg. in drums).....100 lb.	2.35 - 2.50	2.55 - 2.90
Sodium sulphate, crystals (Glauber's salt).....100 lbs.	95 - 1.05	1.15 - 1.50
Sodium sulphide, fused, 60-62 per cent (conc.).....lb.	03 - 04	04 - 05
Sodium sulphite, crystals.....lb.	03 - 03 1/2	03 - 04 1/2
Strontium nitrate, powdered.....lb.	09 - 10	10 - 12
Sulphur chloride, yellow.....lb.	04 - 05	05 - 06
Sulphur, crude.....ton	18.00 - 20.00	
Sulphur dioxide, liquid, cylinders extra.....lb.	08 - 08 1/2	09 - 10
Sulphur (sublimed), flour.....100 lb.		2.25 - 3.10
Sulphur, roll (brimstone).....100 lb.		2.00 - 2.75
Tale—imported.....ton	30.00 - 40.00	
Tale—domestic powdered.....ton	18.00 - 25.00	
Tin bichloride.....lb.	09 - 09 1/2	09 - 10
Tin oxide.....lb.		35 - 37
Zinc carbonate.....lb.	14 - 14 1/2	14 - 15 1/2
Zinc chloride, gran.....lb.	05 - 05 1/2	05 - 06 1/2
Zinc cyanide.....lb.	42 - 44	45 - 47
Zinc oxide, XX.....lb.	07 - 08	08 - 08 1/2
Zinc sulphate.....100 lb.	2.75 - 3.00	3.05 - 3.30

Coal-Tar Products

NOTE—These prices are for original packages in large quantities f.o.b. N.Y.:

Alpha-naphthol, crude.....lb.	\$1.00 - \$1.05
Alpha-naphthol, refined.....lb.	1.10 - 1.15
Alpha-naphthylamine.....lb.	30 - 31
Aniline oil, drums extra.....lb.	14 - 16
Aniline salts.....lb.	22 - 24
Anthracene, 80% in drums (100 lb.).....lb.	75 - 1.00
Benzaldehyde U. S. P.....lb.	1.25 - 1.30
Benzene, pure, water-white, in drums (100 gal.).....gal.	30 - 35
Benzene, 90% in drums (100 gal.).....gal.	28 - 32
Benidine, base.....lb.	85 - 95
Benidine sulphate.....lb.	80 - 85
Benzoic acid, U. S. P.....lb.	60 - 65
Benzoate of soda, U. S. P.....lb.	50 - 55
Benzyl chloride, 95-97%, refined.....lb.	25 - 27
Benzyl chloride, tech.....lb.	20 - 23
Beta-naphthol benzoate.....lb.	3.75 - 4.30
Beta-naphthol, sublimed.....lb.	50 - 55
Beta-naphthol, tech.....lb.	23 - 26
Beta-naphthylamine, sublimed.....lb.	1.50 - 1.60
Carbazol.....lb.	75 - 90
Cresol, U. S. P., in drums (100 lb.).....lb.	12 - 15
Ortho-cresol, in drums (100 lb.).....lb.	16 - 18
Cresylic acid, 97-99%, straw color, in drums.....gal.	53 - 55
Cresylic acid, 75-97%, dark, in drums.....gal.	48 - 50
Dichlorobenzene.....lb.	06 - 09
Diethylaniline.....lb.	65 - 70
Dimethylaniline.....lb.	36 - 38
Dinitrobenzene.....lb.	22 - 25
Dinitrochlorobenzene.....lb.	22 - 24
Dinitronaphthalene.....lb.	30 - 32
Dinitrophenol.....lb.	33 - 35
Dinitrotoluene.....lb.	22 - 24
Dip oil, 25%, ear lots, in drums.....gal.	24 - 26
Diphenylamine.....lb.	59 - 65
H-acid.....lb.	80 - 95
Meta-phenylenediamine.....lb.	90 - 1.00
Monochlorobenzene.....lb.	09 - 11
Monoethylaniline.....lb.	1.05 - 1.25
Naphthalene crushed, in bbls.....lb.	06 - 06 1/2
Naphthalene, flake.....lb.	06 - 07
Naphthalene, balls.....lb.	08 - 08
Naphthionate of soda.....lb.	58 - 65
Naphthionic acid, crude.....lb.	65 - 70
Nitrobenzene.....lb.	10 - 12
Nitro-naphthalene.....lb.	30 - 35
Nitro-toluene.....lb.	15 - 17
N-W acid.....lb.	1.15 - 1.30
Ortho-amidophenol.....lb.	40 - 2.50
Ortho-dichlorobenzene.....lb.	2.15 - 2.20
Ortho-nitro-phenol.....lb.	70 - 75

Ortho-nitro-toluene.....	lb.	\$0.10	—	\$0.13
Ortho-toluidine.....	lb.	.14	—	.18
Para-amidophenol, base.....	lb.	1.25	—	1.30
Para-amidophenol, HCl.....	lb.	1.30	—	1.35
Para-dichlorobenzene.....	lb.	.17	—	.20
Paranitroaniline.....	lb.	.75	—	.77
Para-nitrotoluene.....	lb.	.55	—	.65
Para-phenylenediamine.....	lb.	1.55	—	1.60
Para-toluidine.....	lb.	.90	—	1.00
Phthalic anhydride.....	lb.	.35	—	.38
Phenol, U. S. P., drums.....	lb.	.14	—	.15
Pyridine.....	gal.	1.75	—	2.75
Resorcinol, technical.....	lb.	1.30	—	1.35
Resorcinol, pure.....	lb.	1.75	—	1.80
R-salt.....	lb.	.60	—	.70
Salicylic acid, tech., in bbls.....	lb.	.25	—	.25
Salicylic acid, U. S. P.....	lb.	.26	—	.26
Solvent naphtha, water-white, in drums, 100 gal.....	gal.	.27	—	.32
Solvent naphtha, crude, heavy, in drums, 100 gal.....	gal.	.14	—	.18
Sulphanilic acid, crude.....	lb.	.24	—	.26
Tolidine.....	lb.	1.20	—	1.30
Toluidine, mixed.....	lb.	.30	—	.35
Toluene, in tank cars.....	gal.	.25	—	.28
Toluene, in drums.....	gal.	.30	—	.35
Xyldines, drums, 100 gal.....	lb.	.40	—	.45
Xylene, pure, in drums.....	gal.	.40	—	.45
Xylene, pure, in tank cars.....	gal.	.45	—	.50
Xylene, commercial, in drums, 100 gal.....	gal.	.33	—	.35
Xylene, commercial, in tank cars.....	gal.	.30	—	....

Waxes

Prices based on original packages in large quantities f.o.b. N.Y.

Bayberry Wax.....	lb.	\$0.20	—	\$0.21
Beeswax, refined, dark.....	lb.	.26	—	.28
Beeswax, refined, light.....	lb.	.30	—	.32
Beeswax, white pure.....	lb.	.35	—	.40
Candelilla, wax.....	lb.	.35	—	.36
Carnauba, No. 1.....	lb.	.45	—	.46
Carnauba No. 2, North Country.....	lb.	.25	—	.25
Carnauba, No. 3, North Country.....	lb.	.16	—	.16
Japan.....	lb.	.16	—	.17
Montan, crude.....	lb.	.04	—	.04
Paraffine waxes, crude match wax (white) 105-110 m.p.....	lb.	.04	—	....
Paraffine waxes, crude, scale 124-126 m.p.....	lb.	.02	—	....
Paraffine waxes, refined, 118-120 m.p.....	lb.	.02	—	.03
Paraffine waxes, refined, 125 m.p.....	lb.	.03	—	.03
Paraffine waxes, refined, 128-130 m.p.....	lb.	.04	—	.04
Paraffine waxes, refined, 133-135 m.p.....	lb.	.04	—	.04
Paraffine waxes, refined, 135-137 m.p.....	lb.	.05	—	.05
Stearic acid, single pressed.....	lb.	.09	—	.09
Stearic acid, double pressed.....	lb.	.09	—	.09
Stearic acid, triple pressed.....	lb.	.10	—	.10

Naval Stores

All prices are f.o.b. New York unless otherwise stated, and are based on carload lots. The oils in 50-gal. bbls., gross weight, 500 lb.

Rosin B-D, bbl.....	280 lb.	\$5.45	—	\$5.70
Rosin E-I.....	280 lb.	5.90	—	6.10
Rosin K-N.....	280 lb.	6.40	—	6.90
Rosin W. G.-W. W.....	280 lb.	7.75	—	8.25
Wood rosin, bbl.....	280 lb.	6.25	—	....
Spirits of turpentine.....	gal.	.96	—	.96
Wood turpentine, steam dist.....	gal.	.85	—	....
Wood turpentine, dest. dist.....	gal.	.70	—	.70
Pine tar pitch, bbl.....	200 lb.	....	—	6.00
Tar, kiln burned, bbl. (500 lb.).....	bbl.	....	—	9.50
Retort tar, bbl.....	500 lb.	....	—	9.00
Rosin oil, first run.....	gal.	.36	—	....
Rosin oil, second run.....	gal.	.38	—	....
Rosin oil, third run.....	gal.	.46	—	....
Pine oil, steam dist., sp.gr. 0.930-0.940.....	gal.	1.10	—	....
Pine oil, pure, dest. dist.....	gal.	.95	—	....
Pine tar oil, ref., sp.gr. 1.025-1.035.....	gal.	.46	—	....
Pine tar oil, crude, sp.gr. 1.025-1.035 tank cars f.o.b. Jacksonville, Fla.....	gal.	.35	—	....
Pine tar oil, double ref., sp.gr. 0.965-0.990.....	gal.	.75	—	....
Pine tar, ref., thin, sp.gr. 1.080-1.060.....	gal.	.25	—	....
Hardwood oil, f.o.b. Mich., sp.gr. 0.960-0.990.....	gal.	.25	—	....
Pine wood creosote, ref.....	gal.	.52	—	....

Fertilizers

Ammonium sulphate, f.a.s., N.Y.....	100 lb.	3.25	—	3.40
Blood, dried, f.o.b., N. Y.....	unit	3.55	—	3.65
Bone, 3 and 50, ground, raw.....	ton	27.00	—	28.00
Fish scrap, dom., dried, f.o.b. works.....	unit	3.10	—	3.20
Nitrate of soda.....	100 lb.	2.50	—	2.75
Tankage, high grade, f.o.b. Chicago.....	unit	3.00	—	3.10
Phosphate rock, f.o.b. mines, Florida pebble, 68-72%.....	ton	3.50	—	3.75
Tennessee, 78-80%.....	ton	7.00	—	7.50
Potassium muriate, 80%.....	ton	33.50	—	35.00
Potassium sulphate.....	unit	1.00	—	....

Crude Rubber

Para-Upriver fine.....	lb.	\$0.18	—	.18
Upriver coarse.....	lb.	.12	—	.13
Upriver caucho ball.....	lb.	.13	—	.13
Plantation—First latex crepe.....	lb.	.14	—	.15
Ribbed smoked sheets.....	lb.	.14	—	.15
Brown crepe, thin, clean.....	lb.	.13	—	....
Amber crepe No. 1.....	lb.	.14	—	....

Oils

VEGETABLE

The following prices are f.o.b. New York for carload lots.

Castor oil, No. 3, in bbls.....	lb.	\$0.11	—	\$0.11
Castor oil, AA, in bbls.....	lb.	.12	—	.12
China wood oil, in tanks.....	lb.	.13	—	.14
Coconut oil, Ceylon grade, in bbls.....	lb.	.08	—	....
Coconut oil, Cochon grade, in bbls.....	lb.	.09	—	.09
Corn oil, crude, in bbls.....	lb.	.11	—	.11

Cottonseed oil, crude (f. o. b. mill).....	lb.	\$0.10	—	\$0.10
Cottonseed oil, summer yellow.....	lb.	.12	—	.12
Cottonseed oil, winter yellow.....	lb.	.13	—	.13
Linseed oil, raw, ear lots (domestic).....	gal.	.82	—	.84
Linseed oil, raw, tank cars (domestic).....	gal.	.80	—	.82
Linseed oil, boiled, in 5-bbl lots (domestic).....	gal.	.87	—	.90
Olive oil, denatured.....	gal.	1.15	—	1.17
Palm, Lagos.....	lb.	.07	—	.07
Palm, Niger.....	lb.	.06	—	.06
Peanut oil, crude, tank cars (f.o.b. mill).....	lb.	.10	—	.10
Peanut oil, refined, in bbls.....	lb.	.12	—	.13
Rapeseed oil, refined in bbls.....	gal.	.83	—	.84
Rapeseed oil, blown, in bbls.....	gal.	.85	—	.86
Soya bean oil (Manchurian), in bbls. N. Y.....	lb.	.11	—	....
Soya bean oil, tank cars, f.o.b., Pacific coast.....	lb.	.10	—	....

FISH

Light pressed menhaden.....	gal.	\$0.48	—	....
Yellow bleached menhaden.....	gal.	.53	—	.54
White bleached menhaden.....	gal.	.55	—	.55
Blown menhaden.....	gal.	.61	—	....
Whale Oil, No. 1, crude, tanks, coast.....	gal.	.45	—	.48

Ores and Semi-finished Products

Quotations have not changed since June 7 report

Non-Ferrous Metals

All f.o.b. New York Unless Otherwise Stated

	Cents per Lb.
Copper, electrolytic.....	13.75
Aluminum, 98 to 99 per cent.....	19.00-20.00
Antimony, wholesale lots, Chinese and Japanese.....	5.25-5.30
Nickel, ordinary (ingot).....	36.00
Nickel, electrolytic.....	39.00
Nickel, electrolytic, resale.....	29.00-32.00
Monel metal, shot and blocks.....	32.00
Monel metal, ingots.....	35.00
Monel metal, sheet bars.....	38.00
Tin, 5-ton lots, Straits.....	32.25
Lead, New York, spot.....	5.65-5.75
Lead, E. St. Louis, spot.....	5.35
Zinc, spot, New York.....	5.65
Zinc, spot, E. St. Louis.....	5.30-5.35

All other quotations are unchanged

Refractories

Prices are unchanged since June 7 report

Miscellaneous Materials

All f.o.b. New York, Unless Otherwise Stated

Asbestos, crude No. 1, f.o.b., Quebec, Canada.....	short ton	\$900.00	—	\$1200.00
Asbestos, shingle stock, f.o.b., Quebec, Canada.....	short ton	90.00	—	125.00
Asbestos, cement stock, f.o.b., Quebec, Canada.....	short ton	22.00	—	28.00
Barytes, ground, white, f.o.b. mills.....	net ton	17.00	—	23.00
Barytes, ground, off color f.o.b. mills.....	net ton	13.00	—	21.00
Barytes, floated, f.o.b. St. Louis.....	net ton	23.00	—	24.00
Barytes, crude f.o.b. mines.....	net ton	8.00	—	9.00
Casolin.....	lb.	.14	—	.15
China clay (kaolin) crude, f.o.b. mines, Georgia.....	net ton	6.00	—	8.00
China clay (kaolin) washed, f.o.b. Georgia.....	net ton	8.00	—	9.00
China clay (kaolin) powdered, f.o.b. Georgia.....	net ton	12.00	—	20.00
China clay (kaolin) crude f.o.b. Virginia points.....	net ton	8.00	—	12.00
China clay (kaolin) ground, f.o.b. Virginia points.....	net ton	13.00	—	20.00
China clay (kaolin), imported, lump.....	net ton	14.00	—	20.00
China clay (kaolin), imported, powdered.....	net ton	30.00	—	35.00
Feldspar, No. 1 pottery grade.....	long ton	6.40	—	6.75
Feldspar, No. 2 pottery grade.....	long ton	5.75	—	5.90
Feldspar, No. 1 soap grade.....	long ton	7.00	—	7.50
Feldspar, No. 1 Canadian, for mill.....	long ton	21.00	—	22.00
Graphite, Ceylon lump, first quality.....	lb.	.06	—	.07
Graphite, Ceylon chip.....	lb.	.04	—	.05
Graphite, high grade amorphous crude.....	ton	15.00	—	30.00
Kieselguhr, f.o.b. mines, Cal.....	per ton	40.00	—	....
Kieselguhr, f.o.b. N. Y.....	per ton	55.00	—	60.00
Magnesite, calcined (crude).....	per ton	8.00	—	12.00
Pumice stone, imported.....	lb.	.03	—	.05
Pumice stone, domestic, lump.....	lb.	.05	—	.05
Pumice stone, domestic, ground.....	lb.	.06	—	.07
Shellac, orange fine.....	lb.	.81	—	.82
Shellac, orange superfine.....	lb.	.84	—	....
Shellac, A. C. garnet.....	lb.	.62	—	.63
Shellac, T. N.....	lb.	.80	—	....
Silica, glass sand, f.o.b. Indiana.....	per ton	1.25	—	2.25
Silica, sand blast material, f.o.b. Indiana.....	per ton	2.25	—	4.50
Silica, amorphous, 250 mesh, f.o.b. Illinois.....	per ton	16.00	—	16.00
Silica, building sand, f.o.b. Pa.....	per ton	2.00	—	2.75
Soapstone.....	ton	12.00	—	15.00
Talc, 200 mesh, f.o.b. Vermont.....	ton	7.00	—	12.00
Talc, 200 mesh, f.o.b. Georgia.....	ton	7.50	—	12.00
Talc, 200 mesh, f.o.b. Los Angeles.....	ton	16.00	—	20.00

Ferro-Alloys

Ferrocium, Ferrochrome, Ferromanganese, Ferromolybdenum, Ferrosilicon, Ferrotitanium, Ferrotungsten, Ferroumium, and Ferrovanadium are unchanged from the prices published June 7.

Structural Material

The following base prices per 100 lb. are for structural shapes 3 in. by 1/2 in. and larger, and plates 1/2 in. and heavier, from jobbers' warehouses in the cities named:

	New York	Chicago
Structural shapes.....	\$2.58	\$2.48
Soft steel bars.....	2.48	2.38
Soft steel bar shapes.....	2.48	2.38
Soft steel bands.....	2.98	2.98
Plates, 1/2 to 1 in. thick.....	2.58	2.48

Industrial

Financial, Construction and Manufacturers' News

Industrial Developments

CERAMIC—The Hazleton Brick Co., Hazleton, Pa., has adopted a capacity schedule at its plant, and is said to have orders on hand to insure continuous production throughout the summer.

The Star Porcelain Co., Trenton, N. J., manufacturer of electrical porcelain products, is operating under regular production with full working force. The plant is now running heavy on specialties for radio service.

The Perth Amboy Tile Works, Perth Amboy, N. J., is operating at full capacity with regular working force. The company has orders on hand for a number of months to come. Extensions are being made for increased capacity.

RUBBER—The Electric Hose & Rubber Co., Wilmington, Del., manufacturer of heavy hose and other rubber goods, is running under day and night shifts. Orders are well in excess of production.

The Amazon Rubber Co., Akron, O., is planning to double its present capacity of 100 tires a day before the close of June. Additions are being made to the working force.

The Firestone Tire & Rubber Co., Akron, O., is maintaining production at maximum capacity, and has advanced the wages of all employees in the factory from 9 to 12 per cent. The wages of office workers have been increased 10 per cent.

The rubber industry at Akron, O., is now employing close to 50,000 workers, as compared with about 35,000 employees a year ago, and 80,000 in February, 1920, the peak period.

The Republic Rubber Corp., Youngstown, O., is operating on a two-shift basis at its local plant, giving employment to about 1,000 men. The belting and inner tube branches have recently advanced their schedules to a three-shift basis.

Offers are being made for the plant of the Batavia Rubber Co., Batavia, N. Y., which recently went into the hands of a receiver, and it is expected that operations will be resumed at an early date.

The Studebaker-Wulff Rubber Co., Marion, O., is arranging for a further increase in production from 100 casings and tubes each per day, to 150 each daily.

IRON AND STEEL—The Sloss-Sheffield Steel & Iron Co. has blown in its stack at Florence, Ala., after a suspension of a number of months, making a total of five blast furnaces of the company now in operation.

The Reading Iron Co., Reading, Pa., is increasing operations at its North 9th St. plant, and has placed the universal mill in service, following a suspension since last September. The unit will give employment to about 100 additional men.

The Brier Hill Steel Co., Youngstown, O., has blown in another blast furnace at its plant, following an idle period of a number of months. All stacks at this plant are now in service.

The Tennessee Coal, Iron & Railroad Co., Birmingham, Ala., is completing repairs on three furnaces at its plant and expects to place two of the units in operation at an early date for the production of foundry iron.

The Nagle Steel Co. is increasing operations at its Pottstown Pa., plant. The Glasgow Iron Co., in this same section, is running at its mill and has twelve of its fourteen puddling furnaces in service.

Steel manufacture in the Mahoning Valley section of Ohio and in the Cleveland (Ohio) district is now about 75 per cent of capacity, being held at this basis on account of the coal strike and consequent fuel shortage at certain plants.

The Central Steel Co., Massillon, O., is operating at close to 100 per cent at its different plants, including the National Pressed Steel Co. and the Massillon Rolling Mill Co., recently merged with the Central company. A wage advance of 10 per cent has been made at the mills, effective June 1, affecting about 2,000 employees.

The Robeson Iron Co., Ltd., Robeson, Pa., is arranging to blow in its blast furnace on low-phosphorus iron about the middle of June.

LEATHER—The Benz Kid Co., Lynn, Mass., is increasing production at its local tannery to handle heavy incoming orders.

The Sparrowbush Tanning Co., Sparrowbush, near Port Jervis, N. Y., is developing an increased output at its plant, comprising the former Hammond tannery, recently acquired. It has a capacity of 1,200 sides a day and will soon be running at maximum.

Six of the largest of the twenty-two tanneries at Chicago, Ill., are curtailing production, due, it is stated, to lack of orders. The total decrease in output approximates 40,000 sides a week.

OIL—The Chickasaw Refining Co. is arranging for the early resumption of operations at its Ardmore, Okla., oil refinery, following a shutdown for the last six months.

The Dale Refining Co. has completed the remodeling of the old oil refinery at Humble, Tex., and is now running on a basis of about 350 bbl. of oil daily.

MISCELLANEOUS—The Owens Bottle Co., Pittsburgh, Pa., is making repairs at its Clarksburg, W. Va., plant, and will place the works in operation at an early date.

The Sherwin-Williams Co., Cleveland, O., is running all of its paint and varnish plants at normal capacity. Other paint manufacturers in this district have also adopted full-time operating schedules, with regular working forces.

The United States Cast Iron Pipe & Foundry Co., East Burlington, N. J., is now operating at about 70 per cent of capacity at its different plants throughout the country, as compared with a 55 per cent production basis two months ago.

The Spanish River Pulp & Paper Mills, Ltd., Montreal, Que., has developed a maximum output of 307 tons a day at its Espanola plant, or about 50 tons greater than originally planned.

Construction and Operation

Arizona

MORENCI—The Stargo Mines, Inc., is completing plans for the construction of a new cyanide plant, with initial capacity of about 75 tons a day, estimated to cost close to \$80,000. The General Engineering Co., Salt Lake City, Utah, is engineer.

California

REDLANDS—J. H. Strait & Co. have plans and specifications under way for the construction of a new fruit dehydrating plant in the vicinity of their present work.

Delaware

WILMINGTON—The Wilmington Sugar Refining Co., Christiana Ave. and B St., has foundation work under way for the main building at its new local sugar mill, comprising a 5-story structure, 100x200 ft., estimated to cost about \$800,000, including equipment. W. J. Wayte, Inc., 125 East 46th St., New York, N. Y., is engineer.

WILMINGTON—The Charles Warner Co., Wilmington, has acquired the plants and properties of the American Lime & Stone Co., Tyrone, Holldaysburg and Bellefonte, Pa., comprising chemical limestone land totaling about 7 miles long, with fluxing stone sites and other mineral properties. The holdings are valued at \$3,000,000. The new owner plans extensive operations at the mills, primarily for lime production, and is said to be arranging for a number of extensions and improvements. The company has disposed of a bond issue of \$1,100,000, the proceeds to be used in connection with the project.

Florida

GAINESVILLE—The Standard Fertilizer Co. is planning for the rebuilding of the portion

of its plant destroyed by fire, May 23, with loss estimated at about \$30,000, including equipment.

Georgia

COLUMBUS—The Armour Fertilizer Co., 209 West Jackson Blvd., Chicago, Ill., will commence the immediate construction of a new local plant to replace the portion of its works recently destroyed by fire.

PORT WENTWORTH—The Atlantic Paper & Pulp Co. is planning for the rebuilding of the section of its works, recently destroyed by fire with loss approximating \$50,000, located at Port Wentworth, a suburb of Savannah.

Indiana

INDIANA HARBOR—The Steel & Tube Co. of America, 111 West Washington St., Chicago, Ill., has authorized the immediate preparation of plans for the construction of two new mills at its local works, to be equipped for an annual capacity of about 100,000 tons. To carry out the details of the project a stock issue of \$6,000,000 is planned. Herbert H. Springford is president.

Kentucky

ASHLAND—The Pittsburgh Brick & Tile Co. has been organized under state laws, to construct and operate a plant for the manufacture of brick, tile and other burned clay products. A tract of about 400 acres of land has recently been acquired at Summit, and plans for the initial plant units are nearing completion. The company is headed by A. C. Bailey, W. L. Bybee and S. S. Willis, Ashland.

Louisiana

COVINGTON—A new company is being organized, it is said, to take over and operate the plant of the Covington Moss Works, Inc., soon to be offered at a public sale to satisfy creditors. The plant is equipped for the manufacture of artificial moss, and will be extended and improved by the new owner.

NEW ORLEANS—The Armour Fertilizer Works, 209 West Jackson Blvd., Chicago, Ill., has awarded a contract to Hugger Brothers, Montgomery, Ala., for the rebuilding of the portion of its plant at Shreveport, near New Orleans, destroyed by fire late in April with loss approximating about \$250,000, including equipment. The new structures will cost close to this amount.

SWARTZ—The Huber Carbon Co. has completed plans for extensions in its local mill to double the present capacity, and will commence work at an early date. A new gasoline extraction plant will also be constructed.

NEW ORLEANS—The Richardson Co., Cincinnati, O., manufacturer of composition paper roofing and kindred products, has plans under way for the construction of an addition to the plant of the Century Roofing Co., New Orleans, an affiliated organization, to cost about \$500,000, including equipment.

MONROE—The Constantin Refining Co., Monroe, is completing the construction of a new gasoline-absorption plant in Union County, Ark., and plans to place the mill in service at an early date. It will have an initial capacity in excess of 4,000 gal. a day, and this output will be increased in the future.

Maryland

BALTIMORE—The Patuxent Clay Products Co., 210 Equitable Trust Bldg., will call for bids before the end of the month for the construction of its proposed new plant on property recently acquired at Patuxent. It will be equipped for the manufacture of brick, tile and other burned clay products, and is estimated to cost close to \$100,000 with machinery. I. P. Mills is head.

BALTIMORE—E. J. Callahan & Co., manufacturers of glass products, have leased property at 14-16 West Barre St., for a new local works.

Massachusetts

BOSTON—Fire May 30 destroyed a portion of the building of the Acme White Lead & Color Co., with loss estimated at about \$13,000.

New Jersey

NEWARK—D. E. Evarts, 134 Gifford Ave., Jersey City, has acquired the plant of the Schofield Oil Co., Ave. R, Port Newark district, at a receiver's sale for a consideration of \$160,500, and is organizing a company to operate the business. The plant consists of three main buildings, on site

aggregating about 5½ acres of land, and will be improved by the new owner.

GARWOOD—The Federal Foundry Co. has acquired the local plant of the Garwood Bronze & Iron Co., North Ave., for a new foundry. George H. Cross is president.

LAMBERTVILLE—The Jespersion Newsprint Corp. is planning for the early operation of its local plant, comprising the former mill of the Perseverance Paper Co., lately acquired, for the manufacture of newsprint from used stock by a special process. The equipment is being remodeled and the plant improved, and it is expected to give employment to a large working force. Henry Weeks is treasurer and general manager.

PERTH AMBOY—The Perth Amboy Oil & Terminal Co., recently organized, has acquired a site near the city for a new oil distributing plant, estimated to cost about \$125,000, including equipment. The company is affiliated with the Able Refining Co., Houston, Tex. Luke Mooney, Sewaren, N. J., is president; and A. L. Baker, 25 Broad St., New York, N. Y., treasurer.

New York

YONKERS—The Arlington Chemical Co., 100 Hamilton St., has authorized the preparation of plans for the erection of a new 4-story plant, in the vicinity of Herriott St., estimated to cost in excess of \$50,000. Timmis & Chapman, 315 5th Ave., New York, are architects. John E. Andrus is president.

NIAGARA FALLS—The Defiance Paper Co., Walnut Ave., will soon commence the erection of an addition to its plant to cost about \$200,000, including equipment. The extension will be equipped to give employment to about 100 men.

BINGHAMTON—The F. E. Harris Co., North Chenango St., manufacturer of flavoring extracts, etc., has broken ground for the erection of a 1-story addition, 175x175 ft., estimated to cost about \$42,000, including equipment. The general contract has been let to B. L. Gabriel, Security Mutual Bldg.

LITTLE FALLS—The Barnet Leather Co., 81 Fulton St., New York, has excavations under way for the erection of a 3-story addition to its plant, estimated to cost about \$100,000, including tanning and operating machinery.

LONG ISLAND CITY—The Nichols Copper Co., 25 Broad St., New York, is considering plans for the rebuilding of the portion of its plant on Newtown Creek, destroyed by fire May 27, with loss reported at close to \$200,000, including equipment.

LOCKPORT—The A. W. Jack Corp., Mill St. and North Transit Road, manufacturer of asbestos mill board and kindred products, has awarded a contract to the J. W. Cowper Co., Fidelity Bldg., Buffalo, for the erection of its proposed new 1-story plant, 128x500 ft., estimated to cost close to \$400,000, including machinery. George F. Hardy, 309 Broadway, New York, is engineer.

North Carolina

WAYNESVILLE—The American Mica Mining Corp. is planning for the establishment of a new mica mining and conversion plant. A list of machinery for installation is being arranged. Harry M. Hall is secretary.

Ohio

AKRON—The National Sulphur Co., Constable Hook, Bayonne, N. J., has construction well under way on a new plant at Bettis Corners, comprising a series of seven large buildings and a number of smaller structures. It is purposed to remove the Bayonne works to this location. The new plant will cost about \$400,000, and is expected to be ready for service at an early date. It will give employment to about 350 men.

CLEVELAND—The Colonial Steel Co., Keystone Bldg., Pittsburgh, Pa., has plans under way for the erection of a new building on property recently purchased at 2121 St. Clair Ave., to be equipped as a heat-treating plant.

Oklahoma

HUGO—The local Chamber of Commerce is interested in a plan for the establishment of a local acid and dye plant, utilizing the bois d'arc wood materials from Choctaw County. A company will be organized, according to tentative arrangements, to operate the works.

TULSA—The Sinclair Oil & Gas Co. has arranged an appropriation of \$1,000,000, for the construction of new gasoline extraction plants in the Mid-Continent field, and improvements in its present plants. H. B. Bernard, superintendent of gasoline plants, is in charge.

Pennsylvania

ROCHESTER—The Amercan Borax Co., E. L. Dawes, president, care of the Standard Sanitary Mfg. Co., Bessemer Bldg., Pittsburgh, has awarded a contract to the Austin Co., 16116 Euclid Ave., Cleveland, O., for the erection of a new addition to the plant building of National Glass Co., recently acquired. It will be 50x100 ft., and is estimated to cost close to \$100,000. The existing buildings will be remodeled and improved to accommodate the new works.

LOCK HAVEN—The General Refractories Co., Oliver Bldg., Pittsburgh, is negotiating for the purchase of the plant of the Pennsylvania Fire Brick Co., Beech Creek, near Lock Haven, and upon acquisition, will merge the company with its organization. The plant will be continued in operation and improvements made. The company is also reported to be arranging for the purchase of the plants of the Hiram Swank's Sons Co., at Johnstown and vicinity.

LANCASTER—The Armstrong Cork Co., Liberty and Mary Sts., will soon break ground for the erection of a 1-story addition, 60x60 ft.

PHILADELPHIA—H. Swoboda & Son, Inc., 1027 North Bodine St., manufacturer of leather products, has awarded a contract to the John N. Gill Construction Co., 112 South 16th St., for the erection of a 1-story addition.

SINNAMAHONING—Fire May 26 destroyed a portion of the local powder works of the Grasselli Chemical Co. An official estimate of loss has not been made. The plant is operated in the name of the Grasselli Powder Co. Joseph S. Burton is president.

READING—A new 1-story foundry will be erected at the plant of the Reading Knob Works, about 30x50 ft. C. B. Mongel, 1122 Pennsylvania Ave., Wyomissing, Pa., is architect.

MONTROSE—The Binghamton Limestone Co., Binghamton, N. Y., has preliminary plans under way for the erection of a local plant, estimated to cost in excess of \$50,000, including buildings and equipment. E. E. Kellogg, care of the Kellogg-Jones Co., O'Neil Bldg., Binghamton, is treasurer.

Tennessee

KNOXVILLE—The Kinney Chemical Co. will soon break ground for the erection of a new plant. F. L. Kinney is vice-president and general manager.

Texas

FORT WORTH—The Magnolia Petroleum Co. is reported to be planning for the rebuilding of the portion of its distributing plant, destroyed by fire May 28, with loss estimated at close to \$300,000.

GRAND PRAIRIE—The Prairie Refining Co. is planning for the early operation of its new local oil refinery, now nearing completion. The plant will have an initial output of 300 bbl. per day, including lubricating oils, grease, asphalt, paints, etc., and at a later date will be increased. I. B. Walker is president.

Virginia

COVINGTON—The Town Council will construct a new mechanical filtration plant in connection with the installation of a water-works system. C. P. Barnett, Covington, is consulting engineer.

LYNCHBURG—The Lynchburg Pigment Corp., P. O. Box 428, has leased the local plant of the National Pigment & Chemical Co. for the establishment of a works for the manufacture of ochre, talc and kindred specialties. Operations will be commenced at an early date. John A. Weinman is president.

West Virginia

KENNELWORTH—The Globe Brick Co. is reported to be planning for the rebuilding of the tunnel drying department at its plant, recently destroyed by fire.

LUMBERPORT—The Mound City Glass Co., manufacturer of tumblers and other plain blown glass products, will commence the immediate erection of an addition to its plant to double, approximately, the present output. It will cost in excess of \$40,000.

NITRO—The Carrier Chemical Co., recently organized, has plans under way for the establishment of a local plant for the manufacture of a line of finished chemical products. M. T. Davis, Jr., is president.

HUNTINGTON—The Bishop Sons Co., New Cumberland, W. Va., has plans under consideration for the establishment of a new branch plant for the manufacture of lamp chimneys and kindred products.

Wisconsin

NEENAH—The Valley Paper Mills, Wisconsin Ave., will take bids at once for the erection of their proposed new plant in the Blair Springs district, comprising a main 2- and 3-story mill, 80x160 ft., estimated to cost about \$750,000, including machinery. Edward A. Wettengel, 578 Pierce Ave., Appleton, Wis., is architect and engineer. G. W. Burnside is secretary and general manager.

Canada

KINGSTON, ONT.—The Frontenac Floor & Wall Tile Co. has construction under way on an addition to its plant to double, approximately, the present capacity. Two new kilns will be built to be used primarily for wall tile production. The company has recently completed the installation of a new grinding mill for feldspar production. Everett Townsend is general manager.

MONTREAL, QUE.—The National Electric Products, Inc., recently consolidated with the Dominion Oxygen Co., Ltd., has plans under way for the erection of a number of commercial oxygen plants in different industrial centers in Canada. The enlarged company is closely allied to the National Carbon Co.

New Companies

THE FLANDILL PRODUCTS CORP., New York, N. Y., has been incorporated with a capital of \$25,000, to manufacture chemicals, paints, etc. The incorporators are H. M. Underhill and D. F. Young. The company is represented by C. A. Hand, 123 Liberty St., New York.

THE LABO LABORATORIES, INC., 3733 North Clark St., Chicago, Ill., has been incorporated with a capital of \$25,000, to manufacture chemicals, chemical byproducts, drugs, etc. The incorporators are Ludwig Sayfarth, W. C. McGuire and E. H. Nealis.

THE PREMIER RUBBER CO., Newark, N. J., has been incorporated with a capital of 50,000 shares of stock, no par value, to manufacture rubber products of various kinds. The incorporators are James A. Whitman, John W. Stoddard and W. Howard Demarest, 790 Broad St., Newark.

THE TROPICAL ENGINEERING CO., Tampa, Fla., has been incorporated with a capital of \$30,000, to manufacture fertilizer products. S. W. Allen is president; and W. H. Phillips, secretary, both of Tampa.

THE LINCOLN SOAP & CHEMICAL CO., Bellevue, Pa., has been incorporated under Delaware laws with a capital of \$75,000, to manufacture soaps, chemicals and chemical byproducts. The incorporators are E. Zane and W. H. Butterworth, Bellevue; and L. W. Bewby, Crafton, Pa. The company is represented by the Capital Trust Co. of Delaware, Dover, Del.

MILLER, MILLER & CO., INC., New York, N. Y., has been incorporated with a capital of \$20,000, to manufacture chemicals and chemical byproducts; mineral specialties, etc. The incorporators are M. I. and B. Miller, 950 Union Ave., New York.

THE ARGOL SULPHITE CO., INC., Curtis Bay, Baltimore, Md., has been incorporated with a capital of \$100,000, to manufacture chemicals and chemical byproducts. The company will commence the immediate erection of a new plant at Curtis Ave. and Birch St. The incorporators are John H. Moran, F. Swift Gibson and George A. Whiting.

THE WALKER PETROLEUM CO., Wilmington, Del., has been incorporated under state laws with a capital of \$5,000,000, to manufacture petroleum products. The company is represented by the Corporation Service Co., Equitable Bldg., Wilmington.

G. O. BEEMAN & CO., Detroit, Mich., have been incorporated with a capital of \$10,000, to manufacture chemicals and chemical byproducts. The incorporators are George O. Beeman, Jr., and Charles W. Beeman, 3328 Whitney Ave., Detroit.

THE CONSOLIDATED COPPER MINES CO., Richmond, Va., has been incorporated with a capital of \$2,000,000, to operate copper properties and manufacture refined copper. T. G. Pool is president, and George P. Royster, secretary, both of Richmond.

THE PAN-AMERICAN FIBRE CORP., Wilmington, Del., has been incorporated under state laws with capital of \$1,000,000, to manufacture fiber products. The company is represented by the Colonial Charter Co., Ford Bldg., Wilmington.

THE OLEANDER PETROLEUM CO., Dallas, Tex., has been incorporated with a capital of \$100,000,000 to manufacture petroleum products. The incorporators are J. H. Hill, F. M. Lege, Jr., and C. B. McKinney, all of Dallas.

M. DEMATTIA, INC., New York, N. Y., has been incorporated with a capital of \$12,000, to manufacture chemicals and chemical byproducts. The incorporators are M. Lehman, F. Lowenfels and M. E. Schere. The company is represented by House, Grossman & Vorhaus, 115 Broadway, New York.

THE STANDARD GRAPHITE CO., Los Angeles, Cal., has been incorporated with a capital of \$100,000, to manufacture graphite products. The incorporators are W. R. Morgan, Edward P. Jarvis, and K. R. Morgan, all of Los Angeles.

THE BROOKS CO., Utica, N. Y., has been incorporated with a capital of \$25,000, to manufacture flavoring extracts and affiliated products. The incorporators are S. A. E. M. and V. E. Brooks. The company is represented by S. W. Brooks, Utica.

THE PETROLEUM OILS CORP., Kansas City, Mo., has been incorporated with a capital of \$100,000, to manufacture petroleum products. The incorporators are R. H. Erichsen, L. H. Schwald and H. J. Smith, all of Kansas City.

THE RESPIRE PROCESS PAINT CORP., New York Division, New York, N. Y., has been incorporated with a capital of \$1,000,000, to manufacture paints, varnishes, etc. The company is represented by the Corporation Service Co., Equitable Bldg., Wilmington, Del.

THE MICHIGAN FULLERS EARTH CORP., Hallett (Wexford County), Mich., has been incorporated with a capital of \$400,000, to manufacture refined fullers earth and petroleum products. The incorporators are James E. Evans, Lakewood, O.; John Wall and Charles W. Hoffman, Cleveland, O.

THE STANDARD MAGNESIA MFG. CO., 613 Capitol Ave., Hartford, Conn., has filed notice of organization to manufacture magnesia specialties. C. H. Densmore heads the company.

THE WEST HAVEN RUBBER CO., West Haven, Conn., has been incorporated with a capital of \$200,000, to manufacture automobile tires and other rubber products. The company has purchased the local plant of the Kelly Tire & Rubber Co. from the receiver for a consideration of \$275,000, and will soon place the works in operation. The incorporators are A. F. Egner, J. A. Walsh and George F. Armstrong, president of the Armstrong Rubber Co., Garfield, N. J.

THE SOUTH RIVADAVIA OIL CO., Wilmington, Del., has been incorporated under state laws with a capital of \$1,000,000, to manufacture petroleum products. The company is represented by the Corporation Service Co., Equitable Bldg., Wilmington.

THE UPPER LUBRICATION CO., INC., New York, N. Y., has been incorporated with a capital of \$100,000, to manufacture lubricating oils. The incorporators are M. Ross, F. Hart and W. J. McGirr. The company is represented by W. H. Brady, 280 Broadway, N. Y.

THE UNITED FLUORSPAR & MINERALS CO., Pittsburgh, Pa., has been incorporated under Delaware laws with capital of \$100,000, to operate fluor spar and kindred mineral properties and plants. The incorporators are Louis J. Adler, W. J. Strassburger and J. L. Hukill, Pittsburgh. The company is represented by the Delaware Registration Trust Co., 90 Market St., Wilmington.

THE SAINT ALBANS OIL CO., St. Albans, W. Va., has been incorporated with a capital of \$30,000, to manufacture petroleum products. The incorporators are C. O. Nichols, A. G. Jacobson and Ward Harshbarger, all of St. Albans.

THE SUPERIOR PAINT & VARNISH CO., Wilmington, Del., has been incorporated under state laws with a capital of \$50,000, to manufacture paints, varnishes, etc. The company is represented by the Colonial Charter Co., Ford Bldg., Wilmington.

THE PEP MFG. CO., New York, N. Y., has been incorporated under Delaware laws with a capital of \$10,000, to manufacture abrasive compounds and kindred specialties. The incorporators are Eliot Norton, Alexander H. Jackson and Ralph Root, all of New York. The company is represented by the United States Corporation Co., 65 Cedar St., New York.

THE NEW ENGLAND BRASS CO., 251 Fountain St., New Haven, Conn., has filed notice of organization to manufacture brass and bronze products. The company is headed by A. C. Stowe.

THE TWENTIETH CENTURY CHEMICAL CO., Boston, Mass., has filed notice of organization to manufacture chemicals and chemical byproducts. The company is headed by James Rea, 317 Adams St., Boston.

THE INDUSTRY OIL CORP., Houston, Tex., has been incorporated with a capital of \$100,000, to manufacture petroleum prod-

ucts. The incorporators are W. B. Harr's and J. H. De Metro, both of Houston.

THE HERCULES SILICA ASPHALT CORP., Nashville, Tenn., has been incorporated under Delaware laws with a capital of \$1,000,000, to manufacture special asphalts and kindred products. The incorporators are M. Brumbaugh, Brown Davis and W. B. Evans, all of Nashville. The company is represented by the Colonial Charter Co., Ford Bldg., Wilmington, Del.

THE MONUMENTAL CLAY PRODUCTS CO., 917 Munsey Bldg., Baltimore, Md., has been incorporated with a capital of \$50,000, to manufacture brick, tile and kindred burned clay products. The incorporators are George H. Haines, Joseph J. Flynn and Edwin W. Herrmann.

THE MIDDLETOWN TIRE & RUBBER CO., Wilmington, Del., has been incorporated under state laws with a capital of \$5,000,000, to manufacture automobile tires and other rubber products. The company is represented by the Delaware Charter Co., 904 Market St., Wilmington.

THE SUFFOLK DRUG & CHEMICAL CO., Medford, Mass., has been incorporated with a capital of \$10,000, to manufacture chemicals, chemical byproducts, drugs, etc. B. G. Payzant is president; and John P. McKown, 12 Madison Ave., Medford, treasurer.

THE MUDDLETY VALLEY CLAY PRODUCTS CO., Hookersville, W. Va., has been incorporated with a capital of \$10,000, to manufacture brick, tile and other burned clay products. The incorporators are Porter Herold, K. B. McCue and D. H. Fletcher, all of Persinger, W. Va.

THE BORDERLAND REFINING CO., Mirando City, Tex., has been incorporated with a capital of \$30,000, to manufacture refined petroleum products. The incorporators are P. N. McCullough, J. G. Taylor and L. O. Gleason, all of Mirando City.

THE CENTRAL SILICA CO., 312 Maloney Bldg., Ottawa, Ill., has been incorporated with a capital of \$20,000, to manufacture silica products. The incorporators are E. B. Wilkinson, A. H. Hall and R. I. Thornton.

THE CLEARVIEW BRICK CO., Clearview, Okla., has been incorporated with a capital of \$30,000, to manufacture brick, tile and other burned clay products. The incorporators are James E. Thompson and J. W. Swain, both of Clearview.

THE BEACON SOAP CO., Beacon, N. Y., has been incorporated with a capital of \$25,000, to manufacture soaps and affiliated products. The incorporators are I. Weiss, W. Hamberger and F. W. Mann. The company is represented by V. D. Stearns, Beacon.

WHITE & KLEPPINGER, INC., 2309 Archer Ave., Chicago, Ill., has been incorporated under state laws to manufacture soda, baking powders and kindred products. The incorporators are George H. White, Vernon A. White and John M. Kleppinger.

THE UNITED CHEMICAL PRODUCTS CO., Wilmington, Del., has been incorporated under state laws with a capital of \$250,000, to manufacture chemicals and chemical byproducts. The incorporators are John P. Cann, M. N. Tyson and Henry McKeown, Wilmington. The company is represented by the Delaware Registration Trust Co., 900 Market St., Wilmington.

THE WILLMOTT OIL CORP., Okmulgee, Okla., has been incorporated with a capital of \$400,000, to manufacture petroleum products. The incorporators are C. S. Willmott, John Caruthers and Joseph M. James, all of Okmulgee.

THE CLAY SERVICE CORP., Terra Cotta, Ill., has been incorporated under state laws with a capital of 1,000 shares of stock, no par value, to manufacture burned clay products of various kinds. The incorporators are Justus Chancellor, M. E. Gates and Justus Chancellor, Jr. The company is represented by Thornton & Chancellor, 1014 South Michigan Blvd., Chicago, Ill.

THE B. & R. LEATHER CO., New York, N. Y., has been incorporated with a capital of \$30,000, to manufacture leather products. The incorporators are H. Rubin and E. Berkowitz. The company is represented by Herman Chaityn, 2 Cedar St., New York.

THE KNOX PORCELAIN CO., Wilmington, Del., has been incorporated under state laws with a capital of \$370,000, to manufacture porcelain and affiliated ceramic products. The company is represented by the Corporation Trust Co. of America, du Pont Bldg., Wilmington.

THE CRESCENT RUBBER MFG. & SUPPLY CO., Seattle, Wash., has been incorporated under state laws to manufacture rubber products of various kinds. The incorporators are William Rutherford and associates. The company is represented by Ryan & Desmond, 603 Pantages Bldg., Seattle.

Capital Increases, etc.

THE HAMERSLEY MFG. CO., 25 Park Place, New York, N. Y., manufacturer of waxed papers, with plant at Garfield, N. J., has disposed of a bond issue of \$750,000, the proceeds to be used for general operations, extensions, etc.

THE MIDWEST & GULF OIL CORP., Tulsa, Okla., has filed notice of increase in capital from \$5,000,000 to \$10,000,000.

THE BORO CHEMICAL CO., Binghamton, N. Y., has arranged for an issue of 1,000 shares of common stock, no par value, for general operations, expansion, etc.

THE PLANTATION CONSOLIDATED OIL CO., Bowling Green, Ky., has filed notice of increase in capital from \$350,000 to \$850,000.

THE MIDWEST PAPER CO., 712 Federal St., Chicago, Ill., has filed notice of decrease in capital from \$300,000 to \$200,000.

THE SOUTH RIVADAVIA OIL CO., a Delaware corporation, has filed notice of organization to operate in New York, with a capital of 10,000 shares of stock, no par value. The company is represented by H. R. Stewart, 17 Battery Place, New York.

THE ATLANTIC FOUNDRY CO., Akron, O., has filed notice of decrease in capital to \$985,300.

THE FARMERS' CO-OPERATIVE LIMESTONE CO., Branchville, N. J., has filed an involuntary petition in bankruptcy.

The plant of the FEDERAL OIL & REFINING CO., Oklahoma City, Okla., near Fort Worth, Tex., will be sold by J. C. Eagen, trustee in bankruptcy for the company.

THE THOMAS FURNACE CO., Kinnickinnic Ave., Milwaukee, Wis., manufacturer of pig iron, has arranged for a bond issue of \$850,000, for general operations.

Plans are being perfected for a merger between the CURAN-AMERICAN SUGAR CO., 129 Front St., New York, N. Y., and the NATIONAL SUGAR REFINING CO., same address.

Coming Meetings and Events

ALPHA CHI SIGMA fraternity will hold its seventh biennial convocation at the Marquette Hotel, St. Louis Mo., June 22, 23 and 24.

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE will hold a joint meeting with the Pacific Division of the Association, on the occasion of the annual meeting of the latter, in Salt Lake City, June 22 to 24.

AMERICAN CHEMICAL SOCIETY will hold its fall meeting in Pittsburgh, Pa., Sept. 5 to 9.

AMERICAN ELECTROCHEMICAL SOCIETY will hold its fall meeting in Montreal, Sept. 21, 22 and 23. Headquarters will be at the Windsor Hotel.

AMERICAN INSTITUTE OF CHEMICAL ENGINEERS will hold its summer meeting at Niagara Falls, Canada, June 19 to 22. Headquarters will be at the Clifton Hotel.

AMERICAN LEATHER CHEMISTS ASSOCIATION will hold its nineteenth annual meeting at Bigwin Inn, Bigwin Island, in the Lake of Bays district, Ontario, Canada, on June 21, 22 and 23.

AMERICAN SOCIETY FOR STEEL TREATING will hold its International Steel Exposition and Convention in the General Motors Bldg., Detroit, Mich., Oct. 2 to 7.

AMERICAN SOCIETY FOR TESTING MATERIALS will hold its twenty-fifth annual meeting June 26 to July 1, at Atlantic City, N. J. Headquarters will be at the Chalfonte-Haddon Hall Hotel.

ANNUAL SAFETY CONGRESS OF THE NATIONAL SAFETY COUNCIL will be held in Detroit, Mich., Aug. 28-Sept. 2.

INTERNATIONAL UNION OF PURE AND APPLIED CHEMISTRY will hold a meeting at Lyons, France, June 27 to 30.

NATIONAL EXPOSITION OF CHEMICAL INDUSTRIES (EIGHTH) will be held in New York Sept. 11-16.

NATIONAL EXPOSITION OF POWER AND MECHANICAL ENGINEERING will be held at the Grand Central Palace Dec. 7-13, with the exception of the intervening Sunday.

NATIONAL FERTILIZER ASSOCIATION is holding its twenty-ninth annual convention at the Greenbrier, White Sulphur Springs, W. Va., this week.

NATIONAL LIME ASSOCIATION will hold its annual convention June 14-16 at the Hotel Statler, Cleveland, O.

NEW JERSEY CHEMICAL SOCIETY will meet at Stettens Restaurant, 842 Broad St., Newark, N. J., the second Monday of every month.